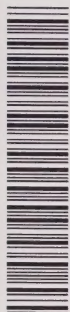


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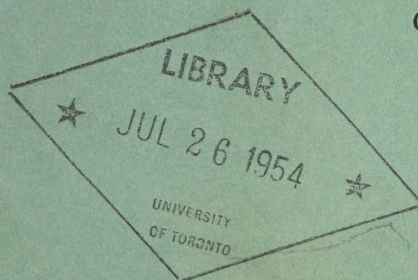


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SOIL SURVEY
of
PRINCE EDWARD ISLAND

by

G. B. WHITESIDE



❧

CHARLOTTETOWN

1950

❧

EXPERIMENTAL FARMS SERVICE

Canada Department of Agriculture in Co-operation with the
Prince Edward Island Department of Agriculture

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INTRODUCTION

It has often been stated, "that man is dependent upon the soil for his existence". The truth of this statement has probably never been more generally recognized than during recent years, as shown by the increasingly widespread interest in soils, their management and conservation.

In order to obtain as rapidly as possible, information concerning the nature of the soils of Prince Edward Island, their inherent characteristics and the relationship of these characteristics to crop production and land use, the Dominion Department of Agriculture, in co-operation with the Provincial Department of Agriculture organized a soil survey of the Island in 1943. The type of survey made was a broad reconnaissance survey, the results of which are presented in this report and accompanying map. The report and map are designed to meet the needs of farmers, landowners, technical agricultural workers and others who may be interested in some particular area of land or district.

The report, which is divided into four main sections, consists primarily of detailed descriptions of each soil mapped. Each description gives specific information by which the soil can be identified, such as colour, texture, arrangement of the profile horizons and the nature of the rock material from which it has been formed. Topography, drainage and amount of stone are also discussed, as these factors are of practical significance in their effect upon the agricultural use of the soil. The relationship between the soil and crop production is also considered to indicate the type of farming practised. For readers unfamiliar with the province a general description of the area surveyed is given in the first part of the report. Another section deals with the factors which are related to soil formation within the area and which have an important bearing on the main characteristics of the soil. A further section of the report deals with the agricultural development, land utilization and soil management.

The soil map which is an important feature of the report, shows the approximate location and extent of the different soils. In addition to the soil boundaries the map shows the roads, railroads, rivers and other topographical features. Several outline maps are also included in the report to show the organization of the province, the major soil-problem areas and land-use classes. Each soil has been given a geographic name by which it may be identified either on the map or in the report.

The section on land use and soil rating gives a tentative classification and a comparison of the different soils from the standpoint of their suitability for the main crops grown in the region. And while the section on soil management cannot offer specific recommendations for individual farms it will serve as a guide to the basic principles necessary to proper soil management and conservation practices necessary to control soil deterioration in the province.

The information contained in this report will assist in a more widespread knowledge of soil conditions pertaining to Prince Edward Island and their relation to the soils of the other Maritime Provinces. It will enable the farmer not only to compare his soil management practices and the productivity of his land with those of other farmers located on soils mapped the same as his own, but will also enable him to utilize the information obtained from experimental work conducted on similar soils. The information obtained in this survey will also provide a basis for further research and investigation, which might be undertaken in order to increase the productivity of the land, for the planning of efficient land use and the study of many other soil problems.

GENERAL DESCRIPTION OF THE AREA

Location and Extent

The Province of Prince Edward Island is a roughly crescent-shaped island lying off the east coast of New Brunswick and the north shore of Nova Scotia, in the Gulf of St. Lawrence.

The Island is situated, approximately between 45° 57' and 47° 04' North Latitude and between 61° 55' and 64° 25' West Longitude. The distances between the Island and the mainland at the nearest points, are nine miles from New Brunswick and fourteen miles from Nova Scotia.

Prince Edward Island is about 145 miles long, in an east-west direction and it varies in width from four miles just west of Summerside to 35 miles at the Queens-Kings county boundary. The area is approximately 2,184 square miles or 1,400,000 acres.

Population

The population of Prince Edward Island, 95,046, as recorded by the 1941 census is mainly Canadian born and 89·1 per cent are Island born. The racial origin of 82·6 per cent of the people is British and of 15·6 per cent is French. There are about 300 Indians of the Micmac tribe on the Reserve located on Lennox Island.

Population density is about 43·5 persons per square mile, the highest in Canada. This density of population is not due to any large industrial centres, rather to the fact that 85 per cent of the land is cleared and largely cultivated and 53·7 per cent of the people live on farms.

The first white settlers came to Abegweit, the Indian name for the Island meaning "Cradled on the Waves", in 1713. Between the years 1713-1763 the Island was a French colony and during this time many Acadians from Nova Scotia and Cape Breton came to build new homes here. They settled mainly around the shores and along the rivers as many of the present place names show—Crapaud, Mount Carmel, Rustico, Pinette, Tracadie and Souris. During this period the population increased to 5,000.

A second period of settlement came after 1763, following the transfer of the province to British rule. This influx was due to the migration of United Empire Loyalists from America and English, Irish and Scottish settlers from the British Isles. The population increased rapidly until the year 1891 when it reached a peak of 109,078. During the next 40 years (1891-1931) a general decline occurred, particularly sharp between 1901-1911, the period of rapid expansion in Western Canada. The decline may be attributed, among other causes, to the rapid depletion of the forest resources with a consequent loss of the lumber industry, to the outmoding of wooden ships bringing an end to a thriving shipbuilding industry, to the centralizing of industry and commerce in Upper Canada, and to the rapid industrial expansion in the United States of America. As a result of such changes the economy of the province came to depend mainly upon agriculture as it continues to do at the present time. The population dependent upon the lost industries and many minor trades migrated to centres of new development while the farm population has remained relatively constant.

TABLE 1.—POPULATION DATA FOR PRINCE EDWARD ISLAND

(Canada Census 1941)

—	1881	1891	1901	1911	1921	1931	1941
Population total.....	108,891	109,078	103,259	93,728	88,615	88,035	95,046
Population total—Urban.....	—	—	—	—	—	20,385	24,340
Population total—Rural.....	—	—	—	—	—	67,653	70,707
Per cent rural.....	—	—	—	—	—	76·8	74·4
Population on farms.....	—	—	—	—	—	55,478	51,067
Per cent of total.....	—	—	—	—	—	63·0	53·7

ORGANIZATION

LOTS or SUB-DIVISIONS..... 22

RAILROAD..... + + + +

FERRY TERMINALS..... —



Organization

Prince Edward Island is divided into three counties, Prince, Queens, and Kings, which are further subdivided into 67 lots (Fig. 1) corresponding in a general way to townships although they do not constitute administrative units. This system of division or organization was established when the first land survey of the province was made in 1763-66.

For administrative purposes, the province is divided into 15 electoral districts. Civil government is administered through the provincial legislature, with municipal councils for the city of Charlottetown and such incorporated towns as Summerside, Kensington, Georgetown and Montague. The rural area is divided into school sections. The capital of the province, Charlottetown, has a population of approximately 14,800. It is situated on Hillsboro Bay at the mouth of the Hillsboro River. Here is located one of the oldest legislative buildings in Canada. It was in this building, in what is known as the Confederation Chamber that the original conference was held leading to confederation of all the British North American colonies. The Dominion Experimental Station is located just outside the city to the northeast.

Summerside, in Prince county, is the only other relatively large centre of urban population. This is a thriving market town on Bedeque Bay. It is also the centre of the fox breeding industry with the Dominion Experimental Fox Ranch located just northeast of the town.

Transportation and Markets

Adequate transportation and marketing facilities are of particular importance to an agricultural region such as Prince Edward Island, which is dependent upon export markets for the disposal of its farm products. The Island is served by one railroad line operated by the Canadian National Railways (Fig. 1). The main line enters the province at Port Borden connecting this port with Charlottetown, the capital, and Summerside. Several branch lines connect the different parts of the Island with the main line and practically all sections of the province are within 10 to 12 miles of a railroad, with 70 per cent or more within 6 or 8 miles.

Distributed along the railroad, at many of the shipping points are storage and shipping warehouses for the handling of potatoes and turnips. While many of these warehouses are only suitable for seasonal use, the larger and more modern buildings are frost proof and designed for year-round service.

Feeding the railroad and providing local transportation facilities is a comprehensive network of roads. While most of the roads are unsurfaced the main highways are either hard surfaced or gravelled and within recent years are accessible most of the year.

Linking the Island with the mainland are two ferry systems. One between Port Borden and Cape Tormentine, New Brunswick, a distance of nine miles and the other between Wood Island and Caribou, Nova Scotia, a distance of 14 miles. The ferry between Borden and Cape Tormentine is part of the C.N.R. System. It provides year-round, daily service, except on Sundays, carrying freight and passenger railway cars as well as trucks and automobiles. The Wood Island-Caribou ferry carries automobiles and lighter type trucks and operates during the months of May to November only.

Charlottetown, Summerside and Georgetown possess harbours capable of handling ocean going ships and provide an important link in the overseas trade with Newfoundland, the British Isles and Atlantic Seaboard markets. There are also a number of smaller harbours, such as Souris, Montague, Victoria, Malpeque, New London and Tracadie. At present these are mainly used by the local fishing fleet.

Within recent years air transportation has been developed bringing to the Island increased opportunities for marketing both agricultural and fisheries products on the American and Central Canadian markets.

With the improvement of the highways a number of bus lines and truck-transport services provide regular service throughout most of the year.

Creameries and cheese factories provide the main outlet for the dairy farms with most of the butter and cheese going on the export market. While some cattle and hogs are processed locally the majority are marketed through the larger packing plants located at Moncton, New Brunswick. Potatoes, both certified seed and table stock, as well as turnips, (table stock), are marketed largely in the United States. Newfoundland provides an important market for many farm products, including live cattle.

Non-Agricultural Resources and Industries

While agricultural land is the most important natural resource of the province, with farming its basic industry, it is of consequence to note some of the other resources of the Island.

In the waters of the Gulf of St. Lawrence and the Northumberland Strait the province has a natural resource which is the source of considerable wealth and employment. In 1946 the revenue derived from the fishing industry amounted to $3\frac{1}{2}$ million dollars. The bulk of the fish and fish products like those of the agricultural industry, are exported, largely, to the American markets. To serve the fishing industry there are some 72 fish processing plants distributed throughout the fishing communities, some of which are co-operatively owned by the fishermen.

Although the province was originally covered with a dense forest, this natural resource was early eliminated as an important source of wealth. While approximately 22.6 per cent of the area is covered by woods there are no extensive forest areas. Most of the wooded land is maintained as farm woodlots, from 1 to 10 acres in size, which are utilized chiefly as a source of fuel supply. Within recent years, however, a limited interest in the pit-prop and pulp-wood trade has developed.

An industry of considerable importance to the Island, and one for which it is widely known, is silver fox breeding. This industry has been maintained by the development of independent fox ranches, also as a side-line to mixed farming. While it was originally confined almost entirely to the production of pelts, the industry expanded as a source of breeding stock and the Island became the original, and a major source of breeding stock for Canada and many other countries. Although subjected to sharp fluctuations in periods of prosperity and depression fox ranching has brought considerable wealth to the province.

FACTORS RELATED TO THE SOILS AND SOIL FORMATION IN PRINCE EDWARD ISLAND

Physiography and Relief

Prince Edward Island is part of what is known, historically and geologically, as the Acadian Region, which includes New Brunswick and Nova Scotia. The Acadian Region, in turn, comprises the Canadian section of the major physiographic region known as the Atlantic Coastal Plain of North America.

The Island has the broad aspect of a low plateau. It is almost trisected by deep bays and a tidal river, the Hillsboro River, to form three small islands. The coast line, approximately 1,000 miles in extent, is indented by numerous bays and the outlets of short tidal rivers and streams. It is characterized, particularly along the south coast, by many long headlands and shore cliffs

of red sandstone capped by a reddish overburden of till. Another feature of the coastline, particularly along the north coast is to be seen in the long, narrow stretches of sand dunes. Unlike the other two Maritime Provinces, New Brunswick and Nova Scotia, there are no areas of dyke-land or reclaimed salt marsh in Prince Edward Island, although there are narrow stretches of salt marsh along estuaries of some of the tidal rivers.

The surface relief of Prince Edward Island generally, is that of a flat to moderately undulating plain. A large part of the Island, from two-thirds to three-quarters, does not exceed 150 feet above sea level. The undulations are relatively long, low and wide. In some areas they assume the character of long, low ridges. There are two sections of the province where the elevations are sufficiently high to give a low hill type of topography. The largest area is found in the centre of the province, extending from near DeSable and Argyle Shore in the south to New London Bay in the north and from the Queens-Prince county boundary in the west to a line running north and south through New Glasgow and Clyde River in the east. The elevations in this area rise to 400 or 500 feet above sea level. A smaller area of rolling land is located in the Culloden-Caledonian sectors of Queens and Kings counties. The valleys in these more rugged areas extend more or less diagonally across the terrain, following in a general way the strike of the rock formations.

Geology

Rock Formations.—As the mineral portion of soils is derived from the weathering of rocks a brief discussion of the rock formations of the province will be of value in understanding the nature of the soils as described in another section of this report.

One of the most obvious features of the rocks of the area is the colour. The dominant colour is red, usually a deep red, although variations in shade will be observed, such variations are associated with the composition of the several kinds of rock.

The native rocks of the province are all sedimentary materials, consisting mainly of comparatively soft, red sandstone, arenaceous shale and red conglomerate with some grey sandstone and concretionary limestone. They are considered to be of the Upper Carboniferous and Permian Ages and are referred to as Permo-Carboniferous rocks. Dawson (2) considered some of the formations to be of Triassic Age.

Sandstones predominate, usually they are thinly bedded and in general lie on a horizontal plane. They are, in the main, soft and friable, in some instances where they are thinly laminated there is a tendency for the exposed layer to peel or shell off, a feature that has given rise to the local name of "shell-rock".

Many of the rocks contain a relatively high proportion of clay particles to form shales which are sometimes referred to as "mudstones". Some of the sandstones and shales contain considerable amounts of mica or sericite flakes, while others are characterized by a high proportion of carbonaceous material.

Lenses, concretions or mottles of greenish-grey material occur in some of the shales, and bands of this material sometimes mark the junction of the shale and sandstone beds. While the matrix or binding material of the rocks appears to be largely ferruginous material it is also found to consist of calcareous material, especially in the red conglomerates, which are frequently called "red limestone". The red colouring of the rocks and also of the soils is due to the presence and the state of oxidation of iron in the composition of the rocks.

Small deposits of concretionary limestone are said to occur at different places in the province, chiefly at Mininigash and Crown Point. Observations made during the survey have not shown any extensive workable deposits of limestone,

and any such material noted has been confined to small lenses or ledges exposed along the shores at low tide. These are usually intermingled with other rocks and are often under water. A rock that is sometimes confused, locally, with limestone and which occurs in many places throughout the Island is a red sandstone conglomerate which has a calcareous matrix.

As mentioned previously the sandstone often has dark carbonaceous material in its make-up; in some cases it constitutes a relatively high proportion of the sandstone, forming a black core. These sandstones resemble some of the sandstones of the carboniferous beds found in Nova Scotia.

The geological formations of Prince Edward Island have not been subjected to any great upheaval of disturbance such as occurred in Nova Scotia or New Brunswick.

Surface Geology.—Overlying the bedrock formations described in the previous section there is a mantle or over-burden of broken down rock material. It is this mantle of rock residues that is of more particular interest to the farmer and the soil specialist than is the bedrock, because it is from the materials forming this mantle that soils are formed. This mantle or overburden is variable in thickness and character depending upon its mode of deposition and its origin or the kind of rock material from which it is formed. The nature of the surface geological deposits is important because it largely determines the texture of the soil, its moisture relationships, also the amount and kind of mineral elements in the soil which supply much of the plant food for crops.

In Prince Edward Island the surface geological deposits consist of unstratified or unsorted drift or till, fluvio-glacial deposits, marine deposits, Aeolian deposits and organic deposits. The unstratified drift covers the greater part of the province. It consists, in part, of glacial till containing materials some of which have apparently been transported from outside the province, also of what might be termed "Glacio-residual" material, that is, material closely related to the local bedrock in its origin and which has only been feebly glaciated and contains little, if any, foreign rock material. It resembles residual material in many sections of the Island. Transported boulders are found on the surface in some sections, particularly in the case of the glacial till areas. These boulders are largely granite and diorite with some gneiss and felsite.

The fluvio-glacial deposits consist of coarse gravelly materials sorted from the glacial till by rapidly moving water. They are of minor extent, occur chiefly on the kame and eskerlike formations in Kings county, and in a few small areas of level terrace or outwash fan-like topography. These deposits are the source of most of the gravel used in road building on the Island.

In the western part of the province there are relatively shallow deposits of medium to fine sand over bedrock or clay till. These deposits occur on nearly level topography around the coastal areas. They are weakly sorted and while no marine fossils were found during the survey, although such have been reported (3), the evidence of deposition and the location of the deposits would suggest old beaches or marine deposits laid down around the time of subsidence of the Island when the elevation was lower than at present. In the estuaries of many tidal rivers and streams there are deposits of silt and clay, known as salt marsh. They are the result of erosion activities and wastage of the surrounding uplands and materials deposited by tidal action.

The Aeolian deposits consist of intermittent ridges of loose, sandy materials, derived from the wastage of the soft sandstones, that have been laid down by water action and reworked by winds. These dune sands extend around the coast but have not penetrated inland to any extent.

Throughout the Island there are a number of organic deposits in different stages of development. They vary from what are known as alder swamps and woody-peat covered with a stunted tree growth of spruce, larch, cedar, alder, etc., to deep deposits of fibrous, mossy-peat covered with ericaceous growth.

Drainage

The natural drainage system of Prince Edward Island is all exterior; the streams and rivers all empty directly into the sea, either into the Gulf of St. Lawrence in the north or into the Northumberland Strait, in the south.

With the exception of four, the Hillsboro, Dunk, York and Mill rivers, the streams are all comparatively short and shallow. All the larger rivers are tidal rivers and have relatively large estuaries cutting deep into the coast line. The effects of the tides carry as far as five to twelve miles up stream. With the exception of the Hillsboro and Dunk rivers there are no alluvial deposits of any note along the river courses. In the case of the two rivers mentioned there are deposits of fluvial material from which has developed the salt marsh. The Dunk River, which is about eighteen miles long, rises in the hilly section of western Queens county and flows in a westerly direction through the undulating, fertile southeastern section of Prince county. The Hillsboro River has its source in the more or less level, semi-swamp area of northwestern Kings county and flows in a southwesterly direction for about 22 miles to Charlottetown where it empties into the Hillsboro Bay. An interesting feature about this river is that it nearly cuts the province into two islands, and was at one time one of the main transportation routes for the eastern part of the Island.

Prince county, particularly west of Summerside, is not so well served with natural drainage channels as are Queens and Kings counties. This fact, in conjunction with the character of the surface relief and the nature of the surface geological deposits, over a large part of the county, is reflected in the natural drainage conditions of the local soils.

In general, drainage conditions of the soils throughout the Island are satisfactory, but as previously stated factors such as surface relief and character of the surface geological deposits or parent materials of the soils have given rise to local variations.

Soils situated on the undulating to rolling topography, particularly in the central and eastern part of the province, where the surface deposits are of the glacio-residual type, are, as a rule, well drained. In some cases drainage may be excessive. However, where the parent material is derived from the finer textured shaly sandstone, invariably giving rise to a clay loam or heavier textured soil, drainage, even on the rolling topography may not be so free. The drainage of the glacial till soils is, on the whole, somewhat slower, even to the point in some soils of being imperfect to poor. The heavy clay loam parent material, which tends to restrict downward movement of the excess water, and the generally smooth topography and lack of adequate drainage channels are responsible for the unsatisfactory drainage conditions. Shallowness to bedrock or clay till, smoothness of topography and lack of adequate natural drainage outlets have given rise to unsatisfactory drainage conditions even for soils developed on the sandier types of parent materials. Much of the poorly drained and semi-swamp woodland areas of the lighter textured soil regions result from the above mentioned factors, as do also the muck and peat deposits.

Climate

Situated as it is between 45° and 47° N. Latitude, and lying in a more or less sheltered position in the Gulf of St. Lawrence, Prince Edward Island is favoured with a relatively moderate climate, which may be classed as humid-temperate. It is largely controlled by precipitation. The climate is also strongly influenced by the close proximity of all parts of the Island to the sea. (Data obtained from the records of the Experimental Station, Charlottetown, are given in tables 2 to 5).

The mean annual precipitation is around 43·07 inches, varying from 31·8 inches in the driest year to 54·56 inches in the wettest year. It is fairly evenly distributed throughout the year, the average monthly total precipitation being about 3·59 inches. Of the total precipitation 11·6 inches is in the form of snow, 82·5 per cent of which falls during the four-month period, December to March. The season of heaviest rainfall is the autumn, September to November, with a rainfall of 12·6 inches.

When considering the amount of rainfall, cognizance should be taken of the number of days on which rain fell, more particularly during the period of active farm operations or the growing season, May to August. A breakdown of the data in table 2 for this period shows there is only a slight variation in the average daily rainfall in an average year and in the wettest and driest years, ·24, ·33, and ·16 inches respectively. When, however, the average number of days on which rain fell, 12, 15 and 11 days respectively, are taken into consideration the differences are more significant from the point of view of farm operations and crop growth.

TABLE 2.—PRECIPITATION DATA—MONTHLY, SEASONAL AND ANNUAL AND EXTREMES FOR CHARLOTTETOWN, P.E.I. (in inches)

36-Year Period, 1910-1945

Month and season	Average monthly fall	Days	Total amount wettest year		Total amount driest year		Snowfall average monthly fall in inches	Greatest amount in one month
	Inches		Inches	Days	Inches	Days		
December.....	4·61	15	7·13	19	1·84	14	24·9	53·2
January.....	4·09	15	5·61	19	3·81	14	26·6	56·1
February.....	3·39	12	3·07	19	1·17	7	25·9	53·5
Winter.....	12·09	42	15·81	57	6·82	35	77·4	56·1
March.....	3·53	13	2·57	14	2·07	13	18·5	66·0
April.....	2·79	13	3·00	12	0·93	7	8·1	24·5
May.....	2·88	13	5·82	18	0·32	6	3·1	8·5
Spring.....	9·20	39	11·39	44	3·32	26	29·7	66·0
June.....	2·97	13	4·31	16	2·91	12	—	—
July.....	3·01	13	5·35	11	1·42	13	—	—
August.....	3·19	12	4·84	17	3·36	13	—	—
Summer.....	9·17	38	14·50	44	6·69	38	—	—
September.....	4·16	13	3·41	15	6·26	21	—	—
October.....	4·46	11	6·03	19	1·37	9	1·8	9·0
November.....	3·99	15	3·42	14	6·39	19	7·3	25·5
Autumn.....	12·61	39	12·86	48	14·02	49	9·1	25·5
Yearly.....	43·07	158	54·56	193	31·8	148	116·2	—

The mean annual temperature as shown by the data in table 3 is around 42·2° F., with the highest and lowest monthly means varying from 78·9° F. in August to 15·5° F. in February. Extreme fluctuations in temperature are not common although temperatures of 98° F. and -23° F. have been recorded.

Taking 42° F. as the critical temperature for plant growth the data in table 3 would indicate a growing period in Prince Edward Island of approximately 180 days, extending from May to October, a period sufficiently long and

warm enough for most common varieties of general farm crops. The occurrence, however, of cold air and water currents and floating ice from the north, in the Gulf of St. Lawrence and Northumberland Strait, late in the spring often causes the spring season to be later than the mean temperatures would indicate. While spring seeding operations at the Experimental Station, Charlottetown, have been recorded as early as April 24, the average date over a 36-year period is around May 11, and the average number of days between the first seeding and the first harvest is around 93 days.

TABLE 3.—MONTHLY, SEASONAL AND ANNUAL MEANS AND EXTREMES IN TEMPERATURE AND AVERAGE VALUES OF BRIGHT SUNSHINE AT CHARLOTTETOWN, P.E.I.

36-Year Period 1910-1945										
Month and season	Monthly mean	Monthly mean maximum	Monthly mean minimum	Highest monthly mean	Lowest monthly mean	Extreme Highest		Extreme Lowest		Average value of bright sunshine (in hours)
						A	B	X	Y	
December.....	24.6	30.8	18.4	37.7	23.1	62.0	48.6	-18	10	60.7
January.....	18.6	26.9	10.7	33.4	17.3	54.0	47.1	-23	-10.6	91.1
February.....	17.2	25.4	9.2	32.4	15.5	53.0	44.1	-21	-9.0	112.5
Winter.....	20.1	27.7	12.8	—	—	62.0	48.6	-23	-10.6	264.3
March.....	26.6	32.9	19.5	41.7	27.1	60.0	58.3	-15	7	136.9
April.....	37.2	44.5	39.6	49.5	39.4	80.0	62.0	5	17.5	159.6
May.....	50.2	59.1	41.7	65.0	48.3	83.0	79.0	20	29.9	212.0
Spring.....	38.0	45.5	33.6	—	—	83.0	79.0	-15	7	508.5
June.....	58.7	67.6	49.5	78.9	63.0	89.0	81.0	33	37.5	221.8
July.....	66.1	74.6	57.6	78.8	70.9	91.0	84.3	37	47.1	245.1
August.....	65.4	73.6	57.2	78.8	68.2	98.0	83.6	41	46	235.9
Summer.....	63.4	71.9	51.4	—	—	98.0	84.3	33	37.5	702.8
September.....	57.9	65.4	49.1	70.5	61.7	88.0	78.0	32	37.8	176.3
October.....	49.5	55.2	41.1	59.6	48.4	80.0	69.3	23	28.7	130.1
November.....	34.8	42.6	30.8	48.2	36.0	66.0	58.8	5	16.3	78.3
Autumn.....	47.4	54.4	40.3	—	—	88.0	78.0	5	16.3	384.7
Year.....	42.2	49.9	34.5	—	—	98.0	—	-23	—	1,860.3

A—Extreme highest on record.

B—Average of extreme monthly maximum.

X—Extreme lowest on record.

Y—Average of extreme monthly minimum.

Table 4 gives a summary of the frost data over a 36-year period, 1910-1945. These data show the average frost-free period, as recorded at Charlottetown, to be around 155 days, with a range of from 131 to 187 days. A comparison of these figures with similar data for points on the mainland shows Prince Edward Island to have a longer frost-free period than is general in Eastern Canada, for instance, 17 days longer than at Sackville, N.B., and 38 days longer than at Nappan, N.S.

TABLE 4.—FROST DATA—EXPERIMENTAL FARM, CHARLOTTETOWN
36-Year Period, 1910-1945

Last Spring Frost		First Fall Frost		Frost Free Period (days)	
Earliest.....	April 28	Latest.....	October 31	Longest	177
Latest.....	May 24	Earliest.....	October 1	Shortest	132
Average.....	May 13	Average.....	October 14	Average	155

A summary of the hours of bright sunshine over a 35-year period is given in table 5. This shows the period of most intensive sunshine to be during the months of July and August, approximately 26 per cent of the total hours for the year. This fact is of importance to potato growers in their spraying operations and calls for care to be exercised in spraying at this time of year.

TABLE 5.—AVERAGE VALUES OF BRIGHT SUNSHINE, IN HOURS

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
91.1	112.5	136.9	159.6	212.0	221.8	245.1	235.9	176.3	130.1	78.3	60.7	1860

The data presented in this section of the report show the climate of the region to be characterized by a long, fairly cold winter; a cool summer; high precipitation and a relatively long frost-free period. These facts should be borne in mind when considering the character of the soils of the province and their management, the type of agriculture followed and conditions affecting crop production.

The effect of climate upon the character of the soils and their natural fertility will be discussed later in the report, in the section dealing with Soil Formation. Considering the data from the standpoint of agriculture it will be noted that so far as amount and distribution of rainfall during the growing season are concerned, conditions are very favourable for the production of hay and pastures. While Prince Edward Island enjoys a longer frost-free period than is general in Eastern Canada, thus favouring a wide range of crops, the comparatively cool growing season emphasizes the importance of rapid growing crops and early maturing varieties.

As is well known, Prince Edward Island is well suited to the production of high quality potatoes. While the climatic conditions generally, favour this crop, the high precipitation, especially at certain periods of the growing season, is also favourable to the development of late blight. It is also favourable to the development of such other crop diseases as apple scab, and brown rot of stone fruits.

A characteristic of the climate of Prince Edward Island, not brought out in the data presented, is the prevalence of local storm centres which strongly influence the local climatic variations within relatively narrow limits.

Vegetation

It is widely recognized that the natural vegetation of any region is the product of the prevailing climate. Climatic conditions of Prince Edward Island have favoured a forest type of climax vegetation.

The character of the forest cover has been described as broad leaved, reflecting a modification in the climate, as compared with other sections of the Acadian Region where the forest is largely coniferous. Because of this difference in general character, the forest cover of Prince Edward Island has been classified as belonging to the Central Section of the Acadian Forest Region.

According to the records of the early settlers and explorers the original forest cover consisted of dense stands of fine trees including oak, maple, beech, birch, spruce, fir, hemlock, and pine, with cedar, yew, ash, willows and many other species around the marshy coasts and in the lowlands.

The present natural vegetation covering the non-arable land consists of second or younger growth trees, numerous species of shrubs and herbaceous plants. The natural vegetation of the uncultivated cleared land includes many different species of grasses and weeds, many of which also occur in the cultivated fields. A partial list of plants characteristic of the natural vegetation of the province is given in the Appendix, table 22. A fuller list is to be found in "Flowering Plants and Ferns of Prince Edward Island." B. Hurst Sr.-Trans. Royal Can. Inst. XIX-2. 1933.

While it is not possible to definitely correlate individual species or species associated with specific soil types, information supplied by local residents indicates in a general way some degree of association.

On the deeper, well drained soils of the glacial till and glacio-residual deposits red oak, sugar maple, yellow birch and beech formed a large proportion of the tree population. Excellent stands of hemlock are reported to have covered the somewhat gravelly and sandier soils of similar geological origin occupying some of the higher ridges. Pure stands of pine covered the lighter textured porous soils of the more or less residual and water-laid deposits. The hemlock and pine are now practically extinct, forest fires, and the ship building and tanning industries having taken their toll. These areas are now covered by mixed woods, largely spruce and fir, or by blueberry and similar barrens.

On the less well drained soils black spruce, larch or tamarack, elm and white cedar were important species. The white cedar is still found in limited quantity and is confined to the western part of the province, Prince county, where it is grown in the imperfectly to poorly drained soils with parent materials having a relatively higher content of calcium than is common to the soils of the region.

Owing to the activities of man subsequent to the settling of the province the character of the natural vegetation has been changed. Many of the less important tree species such as ash, aspen, and alder form a large part of the mixed woods associations. With the opening of the forest canopy many herbaceous shrubs and plants have become established to form a ground cover.

Of the grasses indigenous to the province brown top is the most widely distributed. It is, along with sheep's fescue, common in the natural pasture herbage on the better drained soils. Wild-oat grass is prevalent in the pasture herbage on soils of lower fertility, while Kentucky blue grass occurs on the richer soils. Couch grass is prevalent throughout the province and while it is one of the most troublesome weeds it has a value as a soil stabilizer in retarding surface erosion. On the less well drained soils canary grass, sweet vernal grass and blue joint grass form part of the herbage.

Among the plants which are common, though not indigenous, having been introduced subsequent to the clearing and cultivating of the land, are many weeds which because of their persistence add greatly to the cost of tillage operations. Although not definite indicators of specific soil types, the presence of weeds suggests in some measure, soil conditions such as fertility, texture and drainage. Couch grass and perennial sowthistle apparently prefer friable soils not too low in fertility; the hawkweeds, devil's paint brush and mouse-eared hawkweed, and sorrel indicate strongly acid soils. Yellow-weed or narrow leaved goldenrod and buttercup usually indicate somewhat heavier textured and less well drained soils, while ox-eye daisy and yarrow suggest soils of relatively low fertility. Barnyard grass, lamb's quarter and lady's thumb or smartweed are among the common weeds found on the richer soils.

Within the province there are three minor but distinct soil vegetation associations, treeless bogs or peat areas, dune sands and salt marsh. The vegetation of the bogs is characterized by sphagnum mosses, rhodora, sheep laurel, pitcher plant, leather leaf and small cranberry.

Among the plants established on the dune sands are such salt-tolerant and drought-resistant species as sand-pea, saltwort, sand grass and sea rocket. The presence of such plants retards, to some extent, the drifting of the sand and helps to prevent its encroachment on the better soils of the coastal sections.

On the salt marsh are found glasswort, sea laurel, silver weed, marsh grass, sea-blite and spurrey.

SOILS OF PRINCE EDWARD ISLAND

Soil Survey Methods

As previously stated, in the introduction, the type of survey made was a broad reconnaissance survey. While this type of survey provides a broad picture of the soil pattern of the province it cannot take into consideration the detailed variations that may occur in any locality or on any individual farm.

In making the survey full use was made of the comprehensive networks of roads in the province. These were all travelled, irrespective of conditions, by car mostly, and where necessary on foot. Frequent stops were made for the purpose of examining the soil, the interval between stops was usually one mile, but varied where the complexity of soil conditions required closer examination. This was influenced by the nature of the topography and the character of the landscape, whether it is agricultural land or forested area.

For purposes of studying the characteristics of the soil holes or test-pits were dug and roadside exposures were examined to a depth of two feet or more. Auger borings were also made wherever considered necessary to supplement the more detailed study. The method used and the depth to which the soil was studied depended upon what was most suitable for the particular situation. From these exposures the nature of the different soils was studied according to the changes that occurred with depth. Such external features as relief, drainage conditions, natural vegetation and land use were also noted.

The soil boundaries were plotted on a base map. In some cases the soil changes were more or less abrupt so there was not much doubt regarding where the boundary lines should be plotted on the map. But more often, one soil

merged gradually into another, and under these circumstances soil boundary lines, between points of examination, were drawn arbitrarily according to the lay of the land.

The base maps were supplied by the Topographical Branch of the Department of Mines and Technical Surveys. They are on the scale of 1 inch to 1 mile.

Soil samples representing the different soil series were taken for laboratory studies. Wherever possible an undisturbed profile in a virgin, or nearly virgin, wooded area was selected. Composite surface soil samples from cultivated fields on selected farms on similar soil types were also taken for comparison with the samples from virgin soils and for a study of soil fertility levels.

The soil map accompanying this report is printed on a scale of 2 miles to 1 inch. The map is an important part of a soil survey report. It shows the location and approximate extent of the different soils and miscellaneous land classes identified in the course of the field work with relation to the roads, railroads, buildings and other prominent topographical features.

As previously mentioned the type of survey covered by this report cannot recognize small sectional soil variations. Consequently, while the map shows the broad soil pattern of the province, it is advisable to further examine, with the aid of the map and the report, the soils of any specific farm or small parcel of land.

Nature of Soil

Soil is a natural body consisting of an intimate mixture of mineral material, organic matter, air, water, and a vast population of living organisms of diverse size and kind, including the very important micro-organisms.

The mineral material of the soil is present in the form of gravel, sand, silt and clay particles. The relative proportions of the different sized soil particles determine the soil texture which in turn controls the circulation of air and water through the soil. The nature of the mineral material, its chemical and mineralogical composition will also influence the character of the soil and its plant nutrient reserve.

While the mineral material forms the greater proportion of the soil mass, organic matter is an essential part of a good agricultural soil. Soil organic matter is derived from dead and decomposing plant and animal residues on and in the soil. It exists in the soil largely as a very finely divided dark coloured substance known as humus. The presence of soil organic matter or humus in the soil is important because it is the source of energy for many soil activities, it is the essential source of food for the living organisms in the soil, it is an important source of nitrogen, and it is also necessary for its beneficial effects upon the tilth and moisture-retaining capacity of the soil.

The chemical and biological activities necessary to convert the mineral and organic materials into a suitable medium for plant growth and for the maintenance of a fertile soil could not proceed without the presence of air and water in the soil. The amount of air present in the soil varies inversely with the amount of water. Both air and water circulate through the pore space of the soil consequently the texture, structure and tilth of the soil are important

factors. Water also occurs as a thin film around the soil particles. Air is necessary in the soil. It supplies oxygen for the proper functioning of plant roots and many micro-organisms of the soil; it supplies carbon dioxide which unites with soil water to form a solvent of minerals, and in this way assists in making the minerals available for plant use. The soil water also acts as a carrier of plant nutrients and functions as a nutrient itself.

A true soil teems with living organisms. Each kind of organism has its effect upon the soil. The larger members such as moles and angle worms, by their burrowing, help to aerate the soil as well as aiding in the transfer of material from one part of the soil to another. The micro-organisms are important in bringing about chemical and physical changes. They decompose plant and animal residues, play an important part in the building up and making available of plant nutrients in the soil. They also influence the efficiency of natural and artificial fertilizers added to the soil and are in themselves a source of plant nutrients.

It is evident then, that soil is a complex natural body in which many activities take place.

Soil Development

Soils are the products of a number of factors of environment acting together and one upon the other. The broad effect of these activities has been the accumulation and decomposition of organic matter on and in the soil, the chemical and physical alteration of soil minerals, and the transfer of various substances from one part of the soil to another. The factors that control soil formation and determine the character of the soil are:

- (1) Climate, under which the soil has been developed, through its effect in the alteration of the mineral material and its influence on the type of vegetation growing in a region.
- (2) Biological agencies, or plants and animals, particularly plants, which act upon and modify the mineral material.
- (3) Parent material, its origin, composition and mode of deposition, which affect the chemical and physical make-up of the soil.
- (4) Topography, due to its influence upon drainage, run-off and susceptibility to erosion.
- (5) Drainage, which influences soil air and moisture conditions, also micro-biological activities.
- (6) Age, or the length of time the climatic and biological agencies have been acting upon the parent or mineral material.

As a result of the interaction of all these soil-forming agencies each soil or group of soils possesses certain characteristics which distinguish it from another soil or soil group. These characteristics are observed in what is known as the Soil Profile; that is, a vertical section of the soil extending from the surface downward in which are to be seen a succession of natural layers or horizons. The principal horizons are, for convenience, called the A, B, and C horizons. They correspond in a general way to the surface soil, the subsoil and the parent material. Any one or all of these horizons may be subdivided.

The following diagram shows the general sequence of horizons occurring in the soils of Prince Edward Island, under forest conditions. All the horizons and sub-horizons are not always present in every profile or in each different soil.

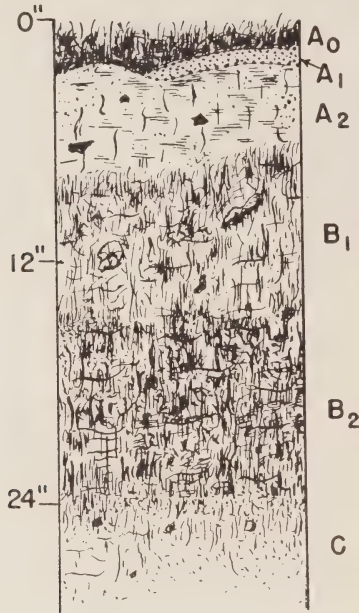


Fig. 2.

- A₀ Forest litter, largely undecomposed.
- A₁ Mixture of well decomposed organic and mineral materials, not always present.
- A₂ Bleached, ashy-grey mineral layer. Horizon of maximum leaching.
- B₁ Yellow-brown or yellowish-red horizon, usually loose and friable, occasionally weakly cemented.
- B₂ Darker coloured, generally reddish, horizon; more firm than above.
- Zone of maximum accumulation.
- C Parent material, partially weathered geological material. In P.E.I. generally red or reddish and derived to greater or less extent from sandstone.

Soils having this general type of profile development are known as Podzols. They are strongly leached soils, comparatively low in plant nutrients and strongly acid in reaction.

The climatic conditions of Prince Edward Island have favoured the Podzol type of development. Under the cool and moist conditions the forest litter (A₀) decomposes slowly and tends to accumulate on the surface. During the process of decomposition various organic acids and other products are released. These acid products are carried down through the soil by the large amount of rain-fall creating an acid condition in the soil and strong leaching occurs. The soluble salts, calcium, magnesia, and potash, and to some extent such minerals as iron and alumina are carried out of the upper part of the soil mass leaving an ash-grey or white layer (A₂). This layer is usually the most strongly acid layer and it is low in plant nutrients and colloidal material. A thin layer of dark mineral soil (A₁) may be found immediately below the organic layer (A₀). This is a layer of mineral material mixed with a relatively high proportion of well decomposed organic matter or humus.

Some of the materials leached out of the A horizons tend to accumulate in the lower part of the soil to form a new horizon (B). The B horizon is usually less acid than the A₂, relatively richer in plant food, and, as a rule, somewhat heavier in texture and more firm. This condition in the B horizon may be due to the accumulation of organic matter, fine clay particles and of iron and aluminum. Occasionally the soil particles become cemented to form a hardpan or ortstein layer, as it is called.

The formation of an ortstein layer is not common to Prince Edward Island soils. Where it occurs it is usually thin and spasmodic or pebbly in character. The hardpan frequently mentioned in the province refers to the compact character of the parent material or C horizon which is the slightly modified geological material from which the true soil has been formed.

In most of the soils of the province the change from the lower part of the subsoil (B₂) to the parent material is gradual. Occasionally other sub-horizons or horizons may be encountered. Under poor drainage conditions a discoloured or mottled layer occurs just below the A₂ or leached layer.

The A and B horizons are often referred to as the Solum or True Soil.

While climate and vegetation are the main factors concerned with soil development within a given region, the nature of the parent material, character of the topography and natural drainage conditions are largely responsible for local soil differences. In Prince Edward Island practically all the soil parent materials are derived largely from sandstones. As the sandstones are, in the main, either lacking or relatively low in bases, and disintegrate fairly readily, the effects of the regional factors, climate and vegetation, have been but slightly modified by those of the local factors. As a result the mass effect of the soil-forming processes is comparatively uniform and the profile characteristics are somewhat similar in practically all soils.

While strong leaching has characterized soil development, as indicated by the well developed A₂ horizon, leaching does not appear to have been carried very deep, with the result soil profiles are not so deep as in some regions where leaching has been less severe.

Although the influence of the parent material has not been so marked as in other regions, close observation has, however, indicated there are variations in the soils which are apparently related to the mineralogical composition of the rock material. These differences are to be noted in the mass colour of the soil, the relative amounts of micaceous and carbonaceous material present, particularly in the parent material, as well as in the general texture and consistency of the soil.

Differences in topography will affect soil development, particularly of local soils within a broad climatic belt. Two of the more obvious effects of topography on soil development are to be observed in the natural drainage conditions and in the degree to which erosion has been active.

The drainage conditions prevailing in a soil affect soil temperatures and aeration. These in turn greatly influence the number, kind and activity of soil micro-organisms. In poorly drained soils micro-biological activity is restricted, organic-matter decomposition is slow and the organic matter tends to accumulate on the surface. The peat bogs of the province are an example of very poor drainage conditions. Drainage conditions are also reflected in the soil colours. Light coloured surface soils and brightly coloured subsoils are indicative of good drainage, while dark coloured surface soils and dull coloured subsoils, especially if accompanied by bluish, yellow or greyish mottling, point to poor drainage conditions. The dull colouring and mottling associated with poor drainage conditions is a feature of a large proportion of the soils of the province at present covered by natural vegetation.

Other conditions being equal the amount of water absorbed by soils from equal rainfall will be greater on level topography than on slopes. Consequently, leaching will be more active, generally, on the smoother relief, whereas on the more rolling topography the amount of surface run-off will be greater, especially where the vegetation is allowed to become thin or where the organic-matter content of the surface soil is depleted. Where such conditions exist accelerated erosion takes its toll of the surface soil, resulting in loss of soil fertility.

Conditions of this kind are to be found in the province as shown by the relatively uniform thickness of the A and A₂ layers on the smoother topography, while on the steeper slopes the solum is somewhat shallower. In many instances the subsoil is exposed or so close to the surface as to give the profile a truncated appearance or to give rise to "bald-spots".

The extent to which soil-forming processes affect the development of the soil in any region depends upon the length of time the parent materials have been subjected to the activities of climate, vegetation and topography. Soils like those of the salt marshes, which are subject to frequent flooding, therefore constant renewal by deposits of new materials, show little or no profile development. Likewise soils that have been exposed to severe and continuous erosion activity are not likely to have fully developed profiles. Such soils are considered to be immature. Soils that have been exposed to the full effect of the various soil-forming agencies over a long period of time will show the full sequence of horizons characteristic of the region in which they occur. The soils of the Island, generally, are of this kind and are known as mature soils. While it is not possible to state definitely the length of time the soils of the area under discussion have been in process of formation, geological studies (7) indicate that from 13,000 to 15,000 years, and perhaps more in this particular region, have elapsed since the retreat of the great ice sheets in Eastern Canada.

Soil Classification

Since there have been many factors responsible for the formation of soils the result has been that many different kinds of soil have been developed. One of the purposes of a soil survey is to classify the different soils into groups or categories (of soils) having similar or closely related characteristics in order to facilitate the study and correlation of soils and soil problems.

Soil Zone and Great Soil Groups.—Prince Edward Island lies in the Podzol Soil Zone, i.e. in a region in which Podzols are the dominant group of well and moderately well-drained soils. The major profile characteristics of this group of soils have already been described (see section on soil formation). In addition to this group, poorly drained or "Glei-Podzol" soils, organic soils and Azonal Alluvial soils also occur in Prince Edward Island. In the Glei-Podzols the leached A₂ horizon, as well as the B horizons are strongly mottled with rust-coloured stains and bluish-grey flecks also occur in the latter horizons. The organic soils have formed from peaty organic accumulations, while the Azonal Alluvial soils have been deposited comparatively recently and they lack the profile development characteristic of the region.

Soil Series.—A number of different soil series may occur within each of the above soil groups. The soils of a series have developed from a particular kind of parent material under the same climatic conditions and under similar drainage conditions. They have the same profile characteristics, the same sequence of horizons, range in colour, thickness and structure of horizons and approximately the same chemical composition. The soil series is the important mapping unit in this survey.

For purposes of identification each soil series is given a name. The name is usually a convenient geographic name taken from the locality where the

particular soil was first identified or where it is most extensive. The naming of soils enables persons interested in soil problems to correlate and utilize the results of experimental work, soil management practices, crop performance and other soil information for similar soils occupying widely separated areas. This gives added practical value to the soil survey.

Eleven soil series have been mapped in this survey. They are: Alberry, Charlottetown, Culloden, Haliburton, Pownall, O'Leary, Egmont, Queens, Dunstaffnage, Kildare and Armadale series.

Owing to the wider variability in texture and constitution of soils of the Armadale series, as found in the different localities where they occur, these should perhaps be considered as comprising more of a Soil Complex than a definite soil series.

Within the province there are three groups of soils which have not been classified in any definite soil series. These are Peat, Dune Sands and Salt Marsh. They are grouped as Miscellaneous Land-Types.

TABLE 6.—KEY FOR THE CLASSIFICATION OF PRINCE EDWARD ISLAND SOILS

A—Soil Zone—Podzol, strongly acid, leached soils.

B₁—Soils developed on glacial till.

C₁—Soils on sandy loam to sandy clay loam parent materials, derived chiefly from Permo-Carboniferous rock material.

D₁—Well to excessively drained series.

1. Culloden sandy loam. Csl

2. Haliburton fine sandy loam. Hfsl

D₂—Well drained series.

3. Charlottetown fine sandy loam. Chfsl

4. Alberry fine sandy loam. Asl

D₃—Moderately well drained series.

5. Pownall fine sandy loam. Pnsl

D₄—Poorly drained series.

6. Armadale sandy loam to loam. Aesl

C₂—Soils on sandy clay loam to clay loam parent materials, derived from Permo-Carboniferous and other rocks.

D₁—Moderately well drained series.

7. O'Leary clay loam. Ocl

D₂—Imperfectly to poorly drained series.

8. Egmont clay loam. Ecl

C₃—Soils on sandy clay loam to clay loam parent material, derived mainly from Carboniferous rock material.

D₁—Moderately well drained to imperfectly drained series.

9. Queens clay loam. Qcl

B₂—Soils developed on water-worked deposits.

C₁—Soils on coarse textured, porous parent materials. Kames, Eskers and Outwash deposits.

D₁—Well to excessively drained series.

10. Dunstaffnage sandy loam. Dsl

C₂—Soils on loamy sand to sandy loam parent materials. Marine modified deposits.

D₁—Well drained series.

11. Kildare sandy loam. Ksl

B₃—Miscellaneous Land-Types.

C₁—Organic soils (Bog)—Poorly decomposed organic deposits twelve (12) inches or more in depth.

12. Peat. P

C₂—Silty to silty clay loam alluvial (marine) deposits.

13. Salt Marsh. S.M.

C₃—Loose sandy deposits—Aeolian-Marine material.

14. Dune Sands. D.S.

The approximate acreage occupied by each soil series is given in Table 7.

TABLE 7.—APPROXIMATE ACREAGE AND PERCENTAGE DISTRIBUTION OF SOIL SERIES FOR TOTAL AREA AND BY COUNTIES

Soil Series	Map Sym- bol	Total Area		Prince County		Queens County		Kings County	
		Acreage	Per cent	Acreage	Per cent	Acreage	Per cent	Acreage	Per cent
Alberry Series.....	A	318,310	23.3	66,435	14.2	129,175	26.5	122,700	29.9
Charlottetown Series.....	Ch	486,070	35.6	152,830	32.6	241,450	49.5	91,800	22.4
Culloden Series.....	C	192,965	14.1	12,350	2.6	71,615	14.7	109,000	26.6
Haliburton Series.....	H	27,340	2.0	27,340	5.8	—	—	—	—
Pownall Series.....	Pn	4,900	0.3	—	—	4,900	1.0	—	—
Armadale Series.....	Ae	141,760	10.4	57,850	12.3	15,250	3.0	68,660	16.7
O'Leary Series.....	O	62,605	4.6	62,605	13.4	—	—	—	—
Egmont Series.....	E	59,180	4.4	59,180	12.6	—	—	—	—
Queens Series.....	—	3,200	0.2	—	—	3,200	0.6	—	—
Dunstaffnage Series.....	D	33,865	2.5	1,335	0.3	18,300	3.7	14,230	3.4
Kildare Series.....	K	18,210	1.3	18,210	3.9	—	—	—	—
Miscellaneous Land- Types:									
Peat.....	P	9,790	0.7	6,440	1.3	1,400	0.2	1,950	0.5
Salt Marsh.....	SM	2,775	0.2	1,275	0.3	1,100	0.2	400	0.1
Dune Sand.....	DS	7,020	0.5	3,420	0.7	2,000	0.4	1,600	0.4
Total.....	—	1,367,990	—	469,260	—	488,390	—	410,340	—

Soil Descriptions

GLACIAL TILL SOILS

The soils developed on glacial till, that is, unsorted parent materials which have been subjected in varying degree to ice action, cover approximately 94.8 per cent of the area surveyed, or about 1,296,300 acres.

Occupying the greater part of the province, the till soils include all the variations in profile characteristics which may be associated with variations in local geological materials. They have, however, many features in common. They all show the general profile characteristics of podzol development, and also some similarity in sequence and colour of horizons. Soil structure is only feebly developed, tends to be crumb-like in the surface soil and nut or small blocky-like in the subsoil. In general, the profile is strongly acid throughout.

The till soils include nine soil series. These may, for purposes of general discussion, be separated into two broad textural groups: (a) Medium textured soils and (b) Moderately heavy textured soils.

The medium textured group includes the Alberry, Charlottetown, Culloden, Haliburton, Pownall and Armadale soils. These soils occupy about 85.4 per cent of the area. They are developed on sandy loam to sandy clay loam parent materials derived principally from the Permo-Carboniferous rocks indigenous to the Island.

Surface soil colours range from light or weak brown to brown, on the well drained sites, to dark brown where drainage is restricted. The subsoils are reddish in colour, friable in the upper section becoming firm to slightly compact in the lower section. The change from subsoil to parent material is, as a rule, gradual, being marked by slight variations in colour, less structure and firmer consistency. Because of the harder consistency of the parent material it is often referred to as "hardpan".

Except for the Armadale series natural drainage is adequate. Under conditions of good tilth the surface soils are mellow and porous; the subsoils,

generally, are easily permeable. Owing to the nature of the relief, character of the subsoil and lack of natural drainage outlets the soils of the Armadale series are poorly drained.

All the soils of the above series are strongly acid in reaction throughout the profile. Local exceptions to this condition occur in the parent material of the Armadale series, particularly west of Summerside where the parent material of this series has been found to be slightly acid to neutral. It is in such localities that white cedar (*Thuja occidentalis*, L.) forms part of the tree growth.

Because of the lack of cohesion the soils of the above mentioned well-drained series, especially where situated on the strongly undulating to strongly rolling topography, are susceptible to damage by water erosion. Particular attention to sound management and tillage practices is essential for the conservation of the soil and maintenance of fertility.

Occupying approximately 121,780 acres, or 9.0 per cent, of the area are three series of heavier textured soils developed on sandy clay loam to clay till. These soils are mapped as the O'Leary, Egmont and Queens series.

While the till from which these soils are developed is composed largely of local rock materials there is apparently sufficient influence of other rock materials, crystalline and Carboniferous sandstone, foreign to the Island, to give rise to soil variations.

In general, the profile of the O'Leary, Egmont and Queens series consists of a grey brown to black clay loam surface soil over a deep or dusky red to purplish red subsoil and parent material. Differentiation of the subsoil and parent material is very gradual. The lower subsoil and parent material are firm to compact and slowly permeable.

The O'Leary and Queens series are among the better agricultural soils of the province. The O'Leary series is the more extensive and occurs on nearly level to gently undulating topography. The Queens series is one of the minor series in extent and occurs on more strongly undulating topography. O'Leary and Queens series are classed as moderately well drained to imperfectly drained soils and they have a moderate to strongly acid reaction.

The Egmont series consists of imperfectly to poorly drained soils occurring on nearly level topography. The upper part of the profile has a moderately to strongly acid reaction with the parent material more variable, in places it has been found to be neutral. The greater proportion of the Egmont soils are under mixed species forest growth, including white cedar where the reaction of the parent material is favourable.

Well Drained to Excessively Drained Series

CULLODEN SERIES

The Culloden series is the third most extensive soil mapped. Located chiefly in the eastern part of the province, particularly in southwestern Kings county and southeastern Queens county, with smaller parcels distributed throughout the province, Culloden soils occupy about 14 per cent of the total area or approximately 192,960 acres.

They are medium to coarse textured, porous soils developed on sandy parent material that owes its origin to the weathering of red, red-brown and brown sandstones. The parent material is glacio-residual or feebly glaciated material which in some sections seems to have been partly modified by water action and resembles terminal moraine deposits.

Culloden soils are generally characterized by the presence of a greater amount of stone or fragments of sandstone on the surface and through the profile than is common with other soils in the province. Where the Culloden soils are

in contact with those of the Dunstaffnage series the surface soil often contains smoothly rounded and hard crystalline pebbles. While the amount of gravel and stone in the profile does not interfere with cultivation it is usually higher than is common to the Alberry and Charlottetown series. Stone fences or dykes along many fields are evidence of much labour spent in clearing the land. Bed-rock may be close to the surface and is frequently encountered at shallow depths.



Fig. 3 Characteristic landscape of large proportion of ulloden sandy loam. Note the sandstone fragments and generally coarse texture of soil exposed in road-bank. On the steep slopes considerable erosion has taken place and as a result the grass cover is very sparse.

The topography of the Culloden soil is undulating to rolling with elevations not so high as in the hilly section of the Charlottetown and Alberry series. A considerable proportion of these soils is covered by woods, particularly in the Culloden-Glen William area where the more rolling topography occurs. Most of the forest is young growth, in many sections being a recent invasion of once cultivated land. The tree species consist of maple, birch, beech, spruce, fir, hemlock and pine. In some localities the stand is largely hardwood whereas in others spruce is dominant. On some of the flatter areas, such as the French Village section of Queens county, scrub growth and blueberries occupy these soils.

Drainage is well established, water circulates freely through the soil owing to the sandy, porous character of the profile. The soils of this series are considered to be dry soils, having a low moisture-holding capacity, hence low resistance to drought.

Cultivated surface soils are pale or light brown to greyish brown in colour, reflecting a low organic-matter content. They are from 4 to 6 inches in thickness, loose and practically structureless. The underlying subsoils are loose, porous sandy loam, frequently gravelly, yellow to light brown in colour and occasionally show a weak cementation or ortstein development.

Sandy loam is the dominant textural class. A description of a representative profile under young growth woods is as follows:

<i>Horizon</i>	<i>Thickness</i> ¹	<i>Description</i>
A ₀	0-1"	Raw leaf and twig debris, very slightly decomposed.
A ₁	½"	Dark grey light fine sandy loam. Structureless and porous. Fairly high organic matter content. Very strongly acid, pH 4.4.
A ₂	3"-6"	Ashy-grey to white loamy sand or sandy loam. Loose and structureless. Contains some small, smoothly rounded pebbles. Irregular development, average thickness 2". Very strongly acid, pH 4.8.
B ₁	4"	Reddish yellow or deep yellowish brown sandy loam. Gritty, structureless and porous. Good root penetration. Very strongly acid, pH 4.7.
B ₂	4"-6"	Light brownish red sandy loam. Firm, friable and permeable. Weakly developed structure. Gritty feel. Frequently contains rounded igneous pebbles. Strongly acid, pH 5.1.
C	Below 16"	Red sandy loam, gravelly to stony. Firm to slightly compact. Permeable. Rock material largely sandstone, with some conglomerate pebbles. Strongly acid, pH 5.1.

Culloden soils differ from the Charlottetown and Alberbury soils by reason of their coarser texture throughout the profile and greater porosity, hence lower drought resistance. In some sections, especially where they are in contact with the Dunstaffnage series there is a considerable amount of smoothly rounded, hard, crystalline pebbles on the surface. In other sections the soil mass has the appearance of terminal moraine material.

Agriculture.—The porous nature and the comparatively coarse texture of the Culloden series, consequently their low moisture-holding capacity are factors that influence the agricultural value of these soils. They are of the type of soil in which fertility is difficult to maintain. This characteristic and their lack of drought resistance cause Culloden soils to be marginal grassland soils, an important consideration from the point of view of livestock production.

As previously stated, a considerable proportion of the Culloden series is under forest cover, largely young growth. Much of these woodland areas was once cleared and under cultivation, but has been allowed to revert to natural vegetation, largely because of unfavourable soil conditions. Much of the land that is at present cleared has either been abandoned or neglected for a considerable number of years and is now covered with a scanty grass vegetation. The grass species are chiefly brown top and such other natural grasses as wild oat grass and poverty grass.

While mixed farming, including dairying, is the basic type of agriculture followed, a large part of the income on most farms, in many cases most of it, is obtained from the potato crop. The average acreage in potatoes is around 4 to 6 acres with some farms having 25 or more. Culloden soils are considered to be well suited to potatoes where liberal applications of fertilizer are used, and a satisfactory organic-matter content is maintained.

Other crops grown are those common to the province generally, oats, mixed grain, timothy and clover hay and field roots. Some attention has been given to the production of vegetable seeds, but as yet this is only done to a limited extent.

In seasons of ample rainfall Culloden soils have produced fairly satisfactory yields, and where a liberal manurial treatment is practised, including the use of heavy applications of fertilizer, as well as lime, the yields compare favourably

¹ Refers to range in thickness of individual horizons.

with those of the stronger soils, but are not so uniformly high. On the whole, however, hay and pasture crops tend to be light, grain short and yields light. Owing to the tendency of these soils to be droughty, late varieties of potatoes may suffer from lack of moisture during late summer.



Fig. 4 A good stand of potatoes on the smoother phases of Culloden sandy loam. This soil type is very responsive to good fertility treatments.

That Culloden soils will respond to good management is indicated by the work done at the Illustration Stations located at Alliston and Iona. The productive capacity of Culloden soils could be materially increased by improved management methods for hay and pasture land. Attention to grassland management would not only increase hay yields and the carrying capacity of pastures, but would also be beneficial in building up and maintaining the fertility of these soils. Improved grass vegetation would also give added protection against erosion damage which is likely to occur where destructive cropping practices have depleted the organic-matter content of the soil and left the surface bare of vegetation.

HALIBURTON SERIES

These are light to medium textured soils developed on parent material derived mainly from soft dusky red, micaceous sandstone, with some dark brown (carbonaceous) sandstone and hard calcareous red conglomerate. Where the dark sandstone and conglomerate occur, it is usually as thin layers interbedded in the lower sections of the rock strata.

The Haliburton series is one of the minor soil types of the province. Occupying about 27,340 acres or 2 per cent of the total area Haliburton soils are confined to Prince county. They are found as small parcels of land distributed chiefly around the coast, more particularly the northwest coast, extending from West Point to North Point.

The surface relief is nearly level, with gentle swells and low knolls, to undulating. In general, the surface relief allows for adequate surface drainage and the subsoil is sufficiently porous to permit the free movement of water through the soil. In seasons of low rainfall Haliburton soils may be temporarily droughty because of the comparative shallowness of the profile and the general texture of the soil.

Surface stones and boulders are not a serious problem with Haliburton soils. The solum is generally free of gravel although it may be plentiful in the parent material, particularly where the parent material is more residual in character and consists of slightly weathered sandstone. Where the conglomerate is present smoothly rounded pebbles form part of the gravel in the soil.

When dry the surface soil is a weak brown or grey brown to moderately dark brown in colour, but when wet it often has a dusky red or chocolate brown cast. It is fine textured, usually a fine sandy loam and is soft and mellow. Structure as a rule is feeble or entirely lacking. Where present it is a small crumb structure which crumbles readily.

A general description of a fine sandy loam profile is as follows:

<i>Horizon</i>	<i>Thickness</i>	<i>Description</i>
A ₀	½" to 2"	Raw leaf mold and partially decomposed forest litter from mixed species tree growth.
A ₁	0" to 1"	Dark greyish brown sandy loam to fine sandy loam. Mellow and porous. Strongly acid, pH 5.4.
A ₂	2" to 5"	Ashy-grey fine sandy loam. Structureless, soft and mellow. Strong to medium acid. pH 5.0 to 6.0.
B ₁	4" to 8"	Yellow brown fine sandy loam. Loose, and mellow. Small crumb-like structure, weakly developed. Strong to medium acid. pH 5.4 to 5.8.
B ₂	8" to 20"	Dusky reddish brown fine sandy loam. Firm to slight compaction. Friable and permeable. Strongly acid. pH 5.6.
C	At variable depth 18" to 36"	Dusky reddish brown fine sandy loam. Firm to slightly compact. Permeable. Contains variable amount of sandstone fragments and some conglomerate pebbles. Soil reaction is variable ranging from strongly acid to very slightly acid.

Haliburton soils as mapped, do not present a consistent profile. In some localities they are residual in character with the parent material having a weakly laminated appearance which is probably due to the natural cleavage of the bedrock. In some sections the profile gives the impression of having been modified to some degree by water action. Where there is a strong influence of the conglomerate rock or where the soils are in contact with the O'Leary soils the parent materials have a slightly higher clay content and drainage may not be so free.

Other soil series found in geographical association with the Haliburton series are the O'Leary, Armadale, Kildare, and Alberry series. A considerable proportion of the Haliburton soils are still covered by woods, chiefly young growth mixed-woods. A large portion of the wooded areas apparently has been cleared and cultivated in earlier times.

Agriculture.—These soils are fair agricultural soils. Their higher content of fine soil particles gives them some advantage over the Culloden series, although soil moisture conditions may be a limiting factor in crop production. They are capable of producing moderately good yields of most of the commonly grown crops, such as oats, mixed grain, timothy and clover hay and turnips.

Generous applications of fertilizer are used, especially for the potato crop. Where lime is used along with manure or fertilizer, good stands of clover are obtained.

Haliburton soils are used for mixed farming and potato growing. Pastures on the whole are of better quality than on the Culloden soils, but could be improved with beneficial results to the building up of soil fertility levels.

Haliburton soils on the slopes are susceptible to erosion with a consequent loss of natural fertility.

Well Drained Series

CHARLOTTETOWN SERIES

The Charlottetown series consists of medium to fine textured soils, developed from glacial or glacio-residual material. This series comprises one of the most important agricultural soils of the province.

Occupying the largest acreage, approximately 486,000 acres or 35.6 per cent of the total area, the Charlottetown soils occur mainly in the central part of the province. They extend in an almost continuous block from Summerside, in Prince county, across Queens county in a northwest-southeast direction to the south central region along the Queens-Kings county boundary line. There are smaller areas in Prince county, extending from Miscouche to Tyne Valley, also in the vicinities of Rosebank, Alma and Greenmount. In Kings county the largest areas are in the Morell-St. Peters sector, and in the Monticello area, in the northern part of the county. Other areas are around Rollo Bay, Souris, Red Point and New Perth, in the southern part of the county.

Charlottetown soils are developed from till that in many sections could be classified as glacio-residual material because of its close relationship to the local bedrock. The rock material is largely soft, micaceous red sandstone, shale or thinly bedded clay shale which in places resembles "mudstone", and some calcareous red conglomerate.

The soils of this series are practically free of surface stone and boulders. Such as there are consist principally of sandstone. The odd granite or crystalline rock is found, more particularly in the western part of the province, although some have been noted along the north shore region of Kings county.



Fig. 5 Charlottetown fine sandy loam. Strongly undulating topography, note landscape and good crops.

Charlottetown soils occur on all types of topography encountered in the survey although the percentage on the hillier topography is small, about 10 per cent. The general nature of the surface relief is broadly undulating. On the whole the nature of the surface relief provides for satisfactory surface drainage, while the permeable character of the subsoil ensures good internal drainage. Over most of the area occupied by the Charlottetown series satisfactory drainage conditions predominate. In the main area poorly drained soils are of small extent and are confined to small areas of flat micro-relief or to depressions too small to map in a reconnaissance survey. The larger areas are mapped as the Armadale series.

Charlottetown soils originally supported an excellent forest growth much of which was hardwoods association consisting of maple, beech, birch and some oak. Present stands are largely second growth or younger, consisting of mixed woods including maple, birch, spruce and fir. The natural vegetation of the uncultivated grasslands is chiefly brown top, which is indigenous to Prince Edward Island.

The cultivated surface soils are light brown in colour, 4 to 8 inches thick, soft and mellow. Structural development is weak although some fields have a soft cloddy appearance after cultivation. The clods are easily pulverized. This cloddy appearance has given rise to the impression that Charlottetown soils are heavier textured than is actually the case.

The prominent features of the Charlottetown soils are: the characteristically bright colour, yellowish-red in the upper subsoil and red in the lower subsoil and parent material; the friable profile, and the presence of soft brownish red to red sandstone fragments.

Surface soils vary in texture from fine sandy loam to very fine sandy loam. In the survey no attempt was made to separate the two textural classes. The fine sandy loam appeared to be dominant and as such was taken as the typical zonal soil. The following description is representative of a fine sandy loam profile under natural conditions and forest cover:

<i>Horizon</i>	<i>Thickness</i>	<i>Description</i>
A ₀	½" to 2"	Dark brown to black organic layer. Slightly decomposed, sometimes felty. Mainly mixed woods litter from spruce-maple association. Very strongly acid. pH 4.0.
A ₂	2" to 6"	Light ashy-grey to white fine sandy loam, sometimes has a pinkish cast. Structure almost absent or very feeble, when present tends to be platy-like or laminated, crushes readily to a powdery condition. Very strongly acid. pH 4.2.
B ₁	4" to 8"	Deep brownish yellow to reddish yellow, fine sandy loam. Weakly developed crumb structure. Loose mellow and porous. Good root concentration. Very strongly acid. pH 4.6.
B ₂	6" to 12"	Weak reddish brown or light brownish red fine sandy loam. Weakly developed structure, nut-like to small blocky in character, slightly firm, easily permeable. Very strongly acid. pH 4.6.
C Below 20" to 24"		Reddish brown or brownish red to red, fine sandy loam to sandy clay loam. Firm but permeable. Contains varying quantities of partially weathered sandstone fragments and the occasional sandstone boulder. Very strongly acid. pH 4.4.

The solum of the Charlottetown soils is fairly uniform throughout the area, although slight variations in shade of colour, texture, degree of structure and thickness of horizons have been observed. The latter is more evident where the soil is more residual in character. The main variations are to be found

in the texture of the parent material and in the mass colour. These differences appear to be associated with local variations in the type of rock material prevalent. Where the rock material is chiefly sandstone the soils are brighter in colour and the parent material is, as a rule, fine sandy loam in texture. A large proportion of shaly material or conglomerate generally gives rise to a heavier textured, sandy clay loam, parent material which tends to have a smoother, siltier consistency and to be sticky when wet, consequently, less permeable than is characteristic of Charlottetown series generally.

Soils of the Charlottetown series will be found forming part of the same landscape as the Alberry and O'Leary series. Where they intermingle, separation is often difficult and boundaries merge gradually. Charlottetown and Alberry soils are found occupying similar topographical positions but the former, as a rule, are brighter coloured soils, somewhat finer or heavier textured and have a slightly deeper profile with, on the whole, less gravel or rock fragments. O'Leary soils are usually found on smoother topography, their mass colour tends to be browner, with greyish brown to dark brown surface soils. They are heavier textured soils than are the Charlottetown series and have not quite so free drainage.



Fig. 6 Representative profile of Charlottetown fine sandy loam. Note grey layer and root penetration well into the sub-soil.

Agriculture.—As previously stated, the Charlottetown series comprises the most important agricultural soils of the province. This is due to the good physical properties of these soils, the areal extent and acreage under cultivation. The landscape is characterized by a large proportion of cleared land laid out in orderly cultivated fields.

While the natural fertility of these soils is not high they will respond readily to good management and are capable of producing satisfactory yields; potatoes 250 to 300 bushels per acre, oats 45 to 50 bushels or more per acre and 2 tons or higher of hay. They are well suited to a wide variety of the common farm crops including potatoes and tree fruits.



Fig. 7 Typical landscape in Erosion Problem area—Charlottetown fine sandy loam. Old erosion gully, sparse grass cover, and invasion of land by spruce. Row crops should be avoided on such slopes, never planted with the slope. Strip cropping recommended when under cultivation.



Fig. 8 Excellent permanent pasture area on 20 to 25 per cent slope. Illustrates efficient land use and stabilization of soil previously subject to severe erosion.

The type of agriculture followed on most of the farms situated on Charlottetown soils is mixed farming combining dairying and potato growing. Most of the large dairy farms are located on these soils. In some sections specialization in beef cattle is followed. Nearly every farm carries 4 to 5 acres of potatoes and many of the large, specialized potato farms are to be found on the Charlottetown series, approximately 60 per cent of the potato acreage of the province.

The principal crops grown for livestock feed are oats, mixed hay, mixed grain, turnips and mangels. Some alfalfa and corn for fodder are also grown, but the acreage is limited although the inclusion of alfalfa in the mixture is gaining in favour.

Surface soils generally are easy to work; they absorb moisture readily, a favourable property which combined with the permeable character of the subsoil makes possible the cultivation of the land soon after rains. The Charlottetown soils are very erosive and consequently a considerable loss of surface soil, and hence of fertility, may take place even on the smoother topography if erosion control practices are not applied. Where the surface relief favours rapid run-off the susceptibility of Charlottetown soils to erosion constitutes a major soil problem. Approximately 9 per cent of these soils can be classed as marginal to non-agricultural land because of the erosion hazard. Extensive erosion control practices have to be applied in these areas if they are to be utilized for farming purposes. Many slopes should be permanently grassed and the very steep slopes would be better utilized as woodland.

ALBERRY SERIES

Occupying approximately 318,300 acres or 23.3 per cent of the total area, the soils of the Alberry series form the second most extensive group in the province. They occur mainly in the eastern part of the Island, particularly in the west-central sections of Kings county extending into Queens county. Another fairly large area is situated in the southwestern part of Queens county; smaller parcels of similar soils are scattered throughout the remainder of the province.

Alberry soils are medium textured, very similar to those of the Charlottetown series in many respects. They are developed on sandy loam to fine sandy loam glacial or glacio-residual parent material. The parent materials are derived principally from reddish brown and brown sandstones, a fairly large proportion of which appear to be of a carbonaceous character. Some shale is also encountered.

There are very few large boulders on the surface of the Alberry soils; such as are found consist mainly of sandstones. The odd granitic boulder occurs in the western part of the province.

The surface soil of this series often has more gravel and sandstone fragments than do the Charlottetown soils, but not in sufficient quantities to interfere with clearing and cultivating the land.

Alberry soils occur on a wide range of topography, from gently undulating to hilly, with the larger proportion occurring on broadly undulating relief. Drainage is well established, the nature of the surface relief assuring adequate run-off and the permeable character of the soil mass permitting free movement of water through the soil.

The original vegetation was much the same as that growing on the Charlottetown series. Present stands of forest growth are largely mixed-woods consisting of spruce, fir, hemlock, maple and birch.

Cultivated surface soils are usually light brown in colour and are relatively low in organic-matter content. They are sandy loam to fine sandy loam in texture, with the fine sandy loam apparently dominant although no separation has been attempted.

The general texture of the profile is somewhat lighter than that of the Charlottetown series, with a slightly grittier feel, indicating a higher percentage of coarse sand particles.

A description of an undisturbed woodland profile, taken north of Iona which is representative of the series, is as follows:

<i>Horizon</i>	<i>Thickness</i>	<i>Description</i>
A ₀	$\frac{1}{4}$ " to $\frac{1}{2}$ "	Thin mat of raw organic matter consisting of undecomposed leaves and twigs from maple-spruce growth.
A ₁	2"	Very dark grey or greyish black sandy loam. Structureless, loose and porous. Moderately high in organic matter. Very strongly acid. pH 5.0.
A ₂	2" to 6"	Light ashy-grey to white loamy sand. Loose, structureless and porous. Very strongly acid. pH 4.3
B ₁	0" to 4"	Bright yellow brown to reddish yellow sandy loam. Loose and porous. Very weakly developed, small crumb structure. Very strongly acid. pH 4.6. Good root concentration.
B ₂	4" to 6"	Light brown sandy loam, firmer than B ₁ . Permeable. Weak structure. Very strongly acid. pH 4.7.
C	Below 18"	Weak reddish brown light sandy loam, gritty feel. Firmer than B ₂ , but permeable. Contains sandstone gravel. Very strongly acid. pH 4.7.

Variations in the Alberry soils, like those of the Charlottetown series, are associated largely with variations in kind and amount of sandstones. Where the dark carbonaceous sandstone is dominant the mass colour is darker, tends to be brown rather than red. There is also a tendency to stronger compaction of the subsoil, frequently at shallower depths. Alberry soils are often found in geographical association with Charlottetown soils, which they closely resemble. Where they intermingle separation is often difficult.

Agriculture.—The type of agriculture followed on this series is much the same as that prevailing on the Charlottetown soils. They are handled in the same manner and have similar problems, namely, fertility, susceptibility to erosion losses and to some extent low moisture supply. Moisture supply, particularly where the organic-matter content is low, may be a limiting factor in some seasons, not being quite so satisfactory as for Charlottetown soils, but on the whole superior to that of the Culloden series.

While the same kinds of farm crops are grown on Alberry soils as on those of the Charlottetown series, yields are somewhat more variable. In some sections when the Alberry soils approach those of the Culloden series in texture and porosity the stand and quality of the grassland herbage reflects the lower moisture-holding capacity. When moisture conditions are favourable and liberal applications of fertilizers are used, Alberry soils are capable of producing highly satisfactory yields, particularly of grain and potatoes.

The effect of a sound management program, including the use of lime, manure and chemical fertilizers is to be seen on the plots of the Illustration Station at Iona, which is located on the lighter phase of the Alberry series.

The agricultural value of about 15 per cent of the Alberry soils, chiefly in the western part of Queens county, is reduced owing to the risk of severe erosion damage. Mismanagement of the soil such as the indiscriminate removal of forest vegetation from the steeper slopes, ploughing and cultivating with the slope, allowing the surface to be bare, either as a result of cultivation or poor grassland management, has accelerated the removal of topsoil with the consequent loss of fertility.

POWNAI SERIES

Pownal soils form one of the minor soil series of the province. They occupy approximately 4,900 acres or 0.3 per cent of the total area. These soils occur in Queens county, the largest block is located between Alexander and Pownal, on the south side of the highway and bordering Hillsborough Bay. Other smaller bodies occur along the Hillsborough and York rivers.

They are relatively fine textured soils developed on fine sandy loam to silty loam or clay loam parent materials derived principally from rock material similar to that of the Charlottetown series. Pownal soils have the appearance of being water-modified and they form a transition between Charlottetown soils and tidal marsh, suggesting that at some time in the past this area may have been subjected to inundation by tidal water.

The surface is free of boulders and the profile, as a rule, is free of stone or gravel, except along the margin where Pownal and Charlottetown soils merge.

The general topography is nearly level to very gently undulating with a general slope towards Hillsborough Bay. Natural drainage conditions, on the whole, are moderately good. Some small pockets of imperfectly drained soil are encountered in depressions or along the site of old water courses where the soils are more alluvial in character.

Cultivated surface soils are brown to dark brown in colour, 6 to 8 inches in thickness, mellow and fine sandy loam to silty loam in texture.

The subsoil is variable in thickness and constitution. It ranges from 12 to 24 inches or more in thickness and consists of mellow, permeable fine sandy loam to silty loam material with lenses or pockets of clay loam. The underlying parent material is a reddish till similar to that of the Charlottetown series.

The dominant textural class is fine sandy loam. A generalized profile description consists of:

<i>Horizon</i>	<i>Thickness</i>	<i>Description</i>
A _k	6" to 8"	Brown to dark brown fine sandy loam. Tendency to a crumb structure. Mellow and loose. pH 5.4 to 5.8.
A ₂	0" to 3"	Ashy-grey fine sandy loam. Structureless, loose and mellow. Seldom present. pH 4.5.
B	12" to 24"	Brownish red to deep reddish brown fine sandy loam to silty loam, with pockets or lenses of clay loam. Firm but friable and permeable. Tends to a thin platy-like structure. pH 4.6 to 5.4.
C Below	18" to 30"	Brownish red fine sandy loam to sandy clay loam or clay loam till derived chiefly from reddish sandstone, arenaceous shale and conglomerate. Soil reaction variable. pH 4.6 to 6.0.

The profile of the Pownal soils is variable depending upon the micro-relief and proximity to other soils. While in general there is evidence of water action having played a part in the deposition and development of these soils they resemble a truncated Charlottetown fine sandy loam in most places.

Agriculture.—Pownal soils are considered to be among the highly productive soils of the area, especially for hay and grain. They are practically all under cultivation and are utilized for mixed farming.

O'LEARY SERIES

The soils of the O'Leary series form one of the more important agricultural soils. They are medium textured soils, in many respects resembling those of the Charlottetown series but differing from them in having a slightly higher content of clay particles, not quite so friable in the solum and somewhat more subdued in colour.

The cultivated surface soil is usually soft and mellow with a tendency to a small crumb structure, however, it may often be small cloddy. The structure is easily destroyed and when dry the surface frequently becomes crusted and may form shrinkage cracks. Under cultivation the surface will often have a small cloddy appearance. The colour of the surface soil varies from a light greyish brown to greyish black or very dark brown, depending upon moisture conditions and organic-matter content. The colour of the surface also often varies with the character of the micro-relief. Frequently the low or depressional areas have a fairly thick, dark coloured surface indicating slow drainage and accumulation of organic matter. In other instances the colour is quite grey, almost white, due to the exposure or mixing of the well developed A_2 horizon with the surface soil. The presence of a relatively thicker A_2 horizon in the less well drained soils indicates they are more strongly podzolized than the better drained soils. Under ordinary conditions the subsoil is moderately permeable but when wet impeded drainage conditions may be found on smooth and in somewhat depressional positions. Differentiation between the subsoil and parent material is gradual. The parent material is slightly compact but not impervious.

Textural classes noted in the field, but not separated, are heavy fine sandy loam, clay loam and some clay. The clay loam appears to be the most extensive.

A representative profile description of a clay loam in a wooded area, in the Locke Road sector consists of:

<i>Horizon</i>	<i>Thickness</i>	<i>Description</i>
A_o	$\frac{1}{2}$ " to 2"	Dark brown to black organic layer, only partially decomposed. Consists of mixed-woods litter. Very strongly acid. pH 4.4 to 4.6.
A_2	3" to 6"	Ashy-grey clay loam to clay, weakly laminated or thin platy structure. Cohesive and slightly puddled when wet. Powdery when dry. Very strongly acid. pH. 4.2 to 4.4.
B_1	4" to 6"	Yellowish brown to light brown loam. Weakly developed crumb structure. Mellow and permeable. May occasionally show slight mottling. Strongly acid. pH 5.4 to 5.6.
B_2	6" to 10"	Light or weak reddish brown or weak brown clay loam. Sometimes has a greyish cast. Macro-structure tends to be platy-like, crushes readily to small angular or nut-like fragments. Firm to slight compaction, less permeable than corresponding horizon of Charlottetown series. Strong to medium acid. pH 5.4 to 5.8.
C	Below 18" or more	Light reddish brown or weak brown clay loam. Compact and slowly pervious. Usually contains rock fragments. Reaction variable, strong to slightly acid. pH 5.4 to 6.2.

Soil variations in the O'Leary series are related largely to the micro-relief which affects drainage, in part to the degree to which the local rock has influenced the parent material and to the proximity of other soil series, such as, the Charlottetown and Egmont series.

Some reference has already been made to the effect of the micro-relief on drainage conditions and as it affects the surface soil. With respect to rock material, where it is of a calcareous nature, such as the red conglomerate, the soils are often deep brown in colour, have a smooth consistency, tend to be more cohesive and not so acid. Similarly when in contact with the Egmont series the subsoil may be hard, stiffer, less permeable and closer to the surface. When in contact with the Charlottetown soils the profile tends to be more friable, somewhat lighter in texture and of a brighter colour than is common to O'Leary soils.

Agriculture.—O'Leary soils occupy about 62,655 acres or 4.6 per cent of the total area. They are considered to be among the stronger and better agricultural soils of the province. Although about 40 per cent of the area is covered with

woods O'Leary soils are well suited to mixed farming and the growing of most general farm crops. In the better developed areas dairying, with cream the main product, and beef cattle production are followed. On most farms potatoes, either for seed or table stock, are grown as a cash crop. In some instances they constitute the principal source of income.

Owing to the physical characteristics of the profile, its texture, structure and consistency, and also the slightly less favourable drainage conditions, O'Leary soils have not so wide a range of crop adaptability as have the Charlotte-town soils. Although some excellent yields of potatoes are obtained these soils are not so well suited to potato production as some of the lighter textured types. At present O'Leary soils provide about 5.0 per cent of the potato area of the province.

Potentially these are good grassland and grain producing soils, approximately 43.0 per cent and 34.0 per cent respectively are used for these crops. Field roots, both turnips and mangels, also corn as a fodder and to a small extent as silage are grown, but the acreage is small.

Under the prevailing practices yields compare favourably with the general average for the province. The value of the grazing lands can be considerably increased by improved pasture management, including the building up and maintenance of the organic-matter content, regular applications of liming materials and the judicious use of fertilizers. Very good results have been obtained by the use of lime and comparatively light applications of nitrogen.

While the lay of the land is favourable to the use of most types of machinery and to ease of cultivation there are some sections in which it may give rise to a temporary drainage problem. In such sections surface drainage can be facilitated by deep furrows at regular intervals to serve as drainage channels.

Surface or sheet erosion is not a problem with these soils generally. It may occur however, on the more undulating areas, especially where the surface has been left bare or where the vegetative cover has been allowed to become thin.



Fig. 9 Smooth topography characteristic of O'Leary clay loam. Note exposed grey layer turned up in ploughing.

QUEENS SERIES

Occupying approximately 3,200 acres or 0.2 per cent of the total area the Queens series forms one of the minor groups of soils. They are glacial till soils developed on clay loam parent material which is derived largely from brown, brownish grey, dark grey and dark reddish brown sandstones.

These soils are mapped only in the China Point—Earnscliffe—Gallows Point area where a lobe of Carboniferous till, similar to the material found in the Cumberland Plain area of Nova Scotia, has been deposited over the red till common to the Island. The thickness of the Queens till, as shown in the cliff at Gallows Point is from 2 to 10 feet.

The general topography is undulating to gently rolling. While the surface relief in general allows for moderately good surface drainage the compact clay parent material causes the downward movement of groundwater to be slow, so that the natural drainage of Queens soils, as a whole, can only be classed as imperfect.

On some of the flatter topography and in depressions both surface and internal drainage are restricted, giving rise to poorly drained soils. Seepage spots may occur on the longer slopes, largely because the compact till restricts the downward movement of excess water and causes it to move laterally over the till. The soil in such localities is likely to be soggy, particularly where the soil is shallow over the till.

Surface stone and boulders are not a serious factor. Some gravel and fragments of sandstone occur through the profile.

The cultivated surface soil is grey to brownish grey and dark brown in colour. These differences are largely dependent on variations in the organic matter or humus content of the soil and on moisture relationships. The thickness of the surface layer is from 4 to 8 inches, under good management it is mellow and has a crumb structure, particularly in well established grasslands. The structure, however, is easily destroyed by improper management, the soil loses its desirable tilth, tends to become hard and cracked in dry seasons. Destruction of the structure leaves the soil susceptible to puddling when wet which often leaves it 'dead' and hard to work. It also increases the hazard of sheet erosion.

The subsurface, when present, is usually grey or yellowish grey in colour. The subsoil is light brown to brown in colour and may show mottling in the upper part. The intensity of the mottling indicates internal drainage conditions; it increases with poorer drainage. As a rule the upper part of the subsoil is friable and porous, the structure is of a thin platy-like character, weakly developed, which crushes readily to a small fragmental condition. In the lower section the subsoil is firm to compact, darker in colour and has a weak fragmental structure. At 20 to 24 inches it grades into a compact, tenacious, clay loam to clay parent material, chocolate brown, deep reddish or purplish red in colour. When moist the mass colour of the subsoil and parent material has a purplish cast. The texture of the surface soil ranges from loam to clay loam. The loam would appear to be the dominant texture. The heavier textured Queens clay loam occurs mainly on the flatter topography. Its drainage is not so free as in the loam and the surface soil is usually darker in colour. In the poorly drained soils the surface soil often has a greyish cast, in other places it is dark grey-brown to black and tends to be mucky. These areas are associated with flat or depressional surface relief; such areas, however, are not extensive.

The following description is representative of a Queens clay loam under forest cover:—

<i>Horizon</i>	<i>Thickness</i>	<i>Description</i>
A ₀	½" to 3"	Black organic layer, fresh and partially decomposed litter from mixed-woods. Very strongly acid reaction.
A ₂	3" to 6"	Ashy-grey, clay loam, tendency to a weak platy structure, crushes readily to a powdery condition. Cohesive when wet. Very strongly acid reaction.
B ₁	5" to 8"	Brown clay loam, weakly developed platy-like structures which crushes readily to a small angular structure. Friable. Very strongly acid reaction.
B ₂	8" to 10"	Darker brown to dark reddish-brown clay loam. Firm to compact, breaks with a nut-like or angular cleavage. Slowly permeable. Very strongly acid.
C below 18" or more		Dark reddish or purplish brown clay loam to clay. Hard, compact and slowly permeable. Variable quantity of rock fragments present. Medium to strongly acid.

In the poorly drained profile mottling occurs at the juncture of the A₂ and B₁ horizon; in extreme cases an A₃, or "Glei-like" layer, may be present. The B horizon or subsoil may not show any marked differentiation, particularly in the shallow profile.

Agriculture.—The Queens series is well suited to general farm crops and grassland, although a relatively large proportion of the area mapped as Queens soil is still under forest vegetation. The cultivated land is used for mixed or livestock farming. The main crops grown are oats, barley, mixed hay, and some field roots. Potatoes are not extensively grown on these soils, the texture and drainage being unfavourable for this crop. Hay and pasture occupy a large proportion of the cleared land. In general yields are higher than for many other soils of the province but the herbage of many fields has been allowed to deteriorate, exposing the surface soil to excessive drying out and increasing the hazard of erosion losses.

The texture of the surface layer gives Queens soils a comparatively high moisture-holding capacity, hence it is able to withstand dry weather conditions better than the lighter textured series. This capacity to absorb and retain moisture also requires these soils to be managed carefully to ensure that they are worked when moisture conditions are at the right stage otherwise, as previously stated, they become puddled and dead, to use a common local expression. When cultivated after such a condition the surface is cloddy, leaving a shallow seed-bed and some time elapses before the soil regains its tilth and productive capacity.

Although considered one of the stronger soils the natural fertility of Queens soils is not very high. For the maintenance of fertility and securing of maximum yields a sound soil management program is essential. Such a program will include the use of liming materials, proper use of fertilizers and the regular application of organic materials, such as well preserved, good quality manure or compost.

Poorly Drained Series

ARMADALE SERIES

The Armadale series is a mixed group or soil complex, the soils of which are found associated with practically all the soils mapped in the province. These soils are developed on variable textured parent materials, ranging from sandy loam to clay loam, having the same geological origin as that of the surrounding or geologically associated soils. Armadale soils are intrazonal soils in which drainage conditions have to a greater or lesser extent masked the broad zonal

effects of climate, vegetation and rock material. As practically all the soils of this series are covered by woods and in many localities are semi-swampy in character, closer mapping was not considered practical for the purposes of this survey.

The Armadale soils comprise the fourth most extensive series in the province. They occupy 10·4 per cent of the total area or approximately 141,760 acres. They are widely distributed throughout the province, the largest blocks are found in Prince county and Kings county where they make up about 12·3 per cent and 16·7 per cent, respectively, of the county areas.

The topography is nearly level to depressional, in most localities natural drainage outlets are lacking. Because of these unfavourable conditions surface drainage is slow to poor. Internal or subsoil drainage also is slow to poor, being influenced by the shallowness of the profile over rock or impervious clay loam till or the presence of a compact or indurated B horizon. A high water-table usually occurs until late in the growing season. In many sections it remains most of the season giving the soils a semi-swampy character.

Surface soils of the cleared areas are usually dark in colour, ranging from dark brown, brownish grey, through greyish black to black, depending upon moisture conditions and the character of the soil. The lighter colours are usually associated with the lighter textured surface soils. In the wetter sections the surface layer assumes a peaty nature. Surface soil textures are variable, ranging from sandy loam to clay loam. In the case of the heavier textures the soils are invariably sticky and puddled.

Below the surface horizon there is often a well developed A₂ layer which usually is thicker than is common to the well drained soils. Generally lacking in structure, it sometimes exhibits a tendency to a thin platy or laminated appearance suggesting that possibly the Armadale soils may have been subjected to water action in some areas.



Fig. 10 Representative profile of Armadale sandy loam. Note thick, bleached (A₂) horizon, which is often mottled with rust coloured streaks and specks.

The subsoils and parent materials are usually a dull, dark red to reddish brown or brown in colour and as a rule show only slight differentiation between horizons, except possibly where the Armadale soils are in contact with the lighter textured series such as the Kildare, Alberry and Cullogen series. In general the subsoil is a sandy clay loam in texture, slowly permeable and showing some degree of mottling. It grades into a sandy clay loam to clay loam parent material which is hard or stiff and practically impervious. Where the profile is of a sandier, lighter textured nature it is frequently underlain, at shallow depths, by an impervious substratum of clayey or rock material. The profile depth varies from 16 to 24 inches.

Surface soils and the upper part of the subsoil are usually strongly to medium acid in reaction. The lower subsoil and parent material are more variable, ranging from strongly acid to almost neutral. In some cases weak effervescence was noted below 30 inches or more. Soil reaction is to some extent associated with the type of rock material dominant in the sector. Where the fine grained shaly material or the red conglomerate is plentiful the soils often are less acid. It was also observed that where cedar was prominent in the vegetation the soil reaction in the lower part of the profile was less acid.

Agriculture.—As previously stated Armadale soils are practically all covered by woods, consisting of spruce, tamarack or larch, alder, swamp maple and in the western part of the province, cedar. There are small clearings scattered on this series. Where such occur they are either on low knolls or where the soil is of a sandy texture. Such clearings are often utilized for a subsistence type of farming, but crops lack vigour and yields are low. Some of the flatter land is utilized for pasture. Armadale soils, however, are generally classed as non-agricultural soils, and as such are better left in woods.

Drainage is the fundamental soil problem with this series. It is a problem which over the greater part of the area presents engineering difficulties due to the lack of natural drainage outlets, consequently, drainage is often an expensive undertaking. Even when drained some of the area occupied by these soils would be only marginal land.

EGMONT SERIES

The Egmont series covers approximately 59,180 acres or 4.4 per cent of the total area. While the distribution, character of the land surface and the origin of the parent materials on which these soils are found are generally similar to those of the O'Leary soils the topography is somewhat flatter and the parent materials are less permeable, having a slightly higher clay content. These two factors are responsible for the poor drainage conditions, both surface and subsoil.

Where cleared the surface soils are dark brown, dark grey or black in colour, having a higher organic-matter content generally than the O'Leary soils. The surface layer is also slightly deeper and when under good grass cover tends to have a moderately good crumb structure. Quite often the subsurface or leached (A_2) layer is thicker than in the better drained soils. It may be laminated and is usually cohesive to sticky and puddled when wet.

The subsoil is reddish brown to dull red in colour, compact, rather dense and plastic when wet. It grades into the dense, compact parent material which is almost impervious.

In some localities an A_3 or glei-like layer may be found between the leached horizon and the subsoil, and the upper part of the subsoil is usually mottled.

A general profile description representative of these soils under woods is as follows:

<i>Horizon</i>	<i>Thickness</i>	<i>Description</i>
A ₀	0" to 1"	Raw leaf mould, maple, birch and spruce.
A ₁	3"	Very dark brown to black. Moderately good crumb structure. High organic-matter content, porous, permeated with fibrous roots. Strongly acid. pH 4.8.
A ₂	3" to 5"	Dull ashy-grey clay. Occasionally shows weak lamination, usually amorphous in character. Sticky when wet. Strongly acid. pH 5.3.
A ₃ or G	0" to 2"	Strongly mottled clay, amorphous. Slightly acid, pH 6.0. Not always present, usually just a thin graduation zone at the bottom of A ₂ .
B ₁	4"	Brownish clay loam or silty clay, tendency to a small blocky structure. Firm to compact, plastic when wet. Slightly acid pH 6.4, grades into—
B ₂	4"	Red silty clay. Similar in structure and consistency to B ₁ . Differentiation not consistent. Very slightly acid to neutral pH 6.6 to 7.0. Slowly permeable.
C	Below 16"	Dull reddish brown or brownish red sandy clay to clay loam. Compact, almost impervious. Carries a variable quantity of rock fragments. Reaction variable depending upon origin.

In the Enmore-Mount Pleasant area where the rock material appears to consist largely of a dusky red, calcareous sandstone the parent material is more tenacious and has a siltier consistency. In the Mount Carmel-Egmont Bay sector there appears to be a local deposit of sand over the clay till the surface tends to be mucky. A detailed survey may require further separation of these areas.

Agriculture.—Egmont soils are classed as marginal agricultural land because of the unfavourable drainage conditions. At the present time most of the area is occupied by woods. Only a small acreage is under cultivation with most of the cleared land being used for rough or natural pasture.

Crop yields generally are only fair. While these are potentially good grass-land soils, many of the pasture areas under prevailing conditions are in a poor state. This results in part from poor management practices which allow the vegetative cover to deteriorate and also from the destruction of the physical condition of the surface soil as a result of puddling caused by cattle trampling it when wet.

The agricultural value of Egmont soils could be increased by drainage. The extent to which this could be undertaken and the system to follow will require careful consideration. Experience in the past with drainage schemes on these soils has indicated many difficulties, such as the lack of adequate outlets, shallowness of the soil, hence difficulty in obtaining sufficient depth, and the problem of sufficient grade over much of the area because of its flat topography.

SOILS ON WATER-WORKED PARENT MATERIALS

The soils on the water-worked parent materials include the Dunstaffnage and Kildare series. They occupy 3.8 per cent of the area, or approximately 52,075 acres.

The Dunstaffnage soils are developed from coarse, poorly sorted sandy, gravelly and cobbly outwash material on kames and eskers. They are excessively drained soils and are little used for agricultural purposes.

The Kildare series are developed from fine sandy marine deposits occurring around the coasts, principally the northeast of Prince county. They contain little gravel, have a somewhat better moisture-holding capacity than the Dunstaffnage soils and have a higher agricultural value.

The profile of both the Dunstaffnage and Kildare soils have the podzol characteristics in common with the till soils previously described.

DUNSTAFFNAGE SERIES

The Dunstaffnage series consists of porous soils developed on waterlaid parent materials. The rock material may be either water-rounded sandstone gravel or smooth igneous gravel similar to the pebbles in the red conglomerate. Occasionally lenses of a tenacious silty clay are found at the lower depths of this sorted material. This clay, as a rule, is high in free carbonates.

Dunstaffnage soils cover approximately 33,860 acres or 2.5 per cent of the province. They are located chiefly in the eastern part of the Island, the largest blocks being in the Dunstaffnage, Selkirk-Caledonia, Belle River and Rollo Bay sectors of Kings and Queens counties. Smaller parcels of the same soil are located throughout the Island, usually along stream courses.

These soils are associated with the kame and esker-like topography, the surface relief is strongly undulating to rolling and is characterized by long, narrow ridges or relatively low oval hillocks. In some parts of Kings county where Dunstaffnage soils merge with those of the Culloden series the relief is smoother forming low, gentle swells.

Surface boulders are not a serious factor, although some are encountered. Smoothly rounded pebbles of igneous and sandstone material in varying quantities are found in the solum with the parent material consisting largely of sorted materials of similar origin. Where sandstone material predominates sorting is not so evident. These soils are a source of gravel used in road building.

The natural vegetation now present on this series is composed of young growth mixed-woods, or blueberry bushes, bracken, sweet fern, sheep laurel and other similar plants common to barrens. Part of the original forest cover consisted of pine, but only the occasional tree of this species is now found.

Owing to the nature of the relief and the porosity of the soil mass natural drainage, both surface and subsoil is rapid to excessive. Dunstaffnage soils lack moisture-holding capacity and represent one of the more droughty soils of the region.



Fig. 11 Characteristic topography of the Dunstaffnage series.

Surface soils in the cleared areas are light in colour, greyish to weak brown. They are loose, structureless, usually low in organic-matter content and from 2 to 6 inches thick. They absorb moisture readily but dry out rapidly and where unprotected are likely to drift to some extent. The subsoil is loose and porous. The quantity of gravel in this layer is variable. Although some profiles exhibit a weak Ortstein development, that is the soil particles are cemented to form an intermittent hardpan, the condition is not general in distribution.

In the Dunstaffnage area the parent material is largely sandstone rock material and sand weakly sorted, but in southern Kings county it consists of sorted sand and igneous pebbles with outcrops and boulders of greyish conglomerate. In some sectors a deep red, tenacious and calcareous silty clay occurs at various depths below the solum.

Surface soil textures are loamy fine sand to light fine sandy loam. A generalized profile description is as follows:

<i>Horizon</i>	<i>Thickness</i>	<i>Description</i>
A ₁	2" to 6"	Gray to weak brown loamy fine sand to fine sandy loam. Low in organic-matter content, loose and structureless. Smoothly rounded gravel frequently present. Strongly acid.
A ₂	4" to 10"	Light ash-grey loamy sand. Loose and powdery. May contain small pebbles. Strongly acid.
B ₁	4" to 8"	Light brown loamy sand to sandy loam. Usually loose and structureless, may be weakly cemented to form ortstein. Strongly acid.
B ₂	6" to 10"	Light brown or weak reddish brown sandy loam, practically structureless. Loose, gravelly and porous. Strongly acid.
C	Below 22" or more	Brown or weak reddish brown sandy loam. Gravelly to stony. Sometimes firm to slightly compact but friable and porous. Variable degree of sorting. Reaction variable.

Agriculture.—Dunstaffnage soils are classed as marginal to sub-marginal agricultural soils. The open, porous nature of the soil, hence low drought resistance and retentive capacity encourage rapid leaching and loss of fertility.

While a considerable proportion of these soils have been cleared and at one time cultivated much of the cleared land is now under a scanty cover of native grasses such as brown top and wild oatgrass, many weeds also form a large part of the herbage.

Where cultivated the crops are light and yields are low, may even be total failure. These are soils which are difficult to maintain at a satisfactory level of fertility. Utilization of these soils for woodland would seem to be a desirable policy.

KILDARE SERIES

The Kildare series consists of light textured soils developed on weakly sorted sandy parent materials. They are relatively shallow soils, deposited over native rock or over the red till common to the Island region. Their distribution and general character would suggest that Kildare soils are marine deposits, probably laid down at a time when the general elevation of the province was at a lower level than at present.

Kildare soils occupy approximately 18,210 acres, or 1.3 per cent of the total area, forming one of the less extensive soil series. They are distributed mainly around the coastal areas of Prince county with some isolated parcels inland. The larger areas occur along the northeast side of the county, extending intermittently from North Point to Bideford. Other less extensive areas are located in the vicinity of Searletown, in the Brae-West Point sector, and near Miminigash, with some small areas distributed throughout the county.

With the exception of the occasional granite boulder Kildare soils are free of surface stone. Some gravel may be found in the parent material, but the solum or upper part of the profile, as a rule, is stone free.

The landscape of this series, generally, is that of a gently undulating plain with stretches of flat surface relief broken by gentle swells and low knolls. Although the surface relief is level to gently undulating, surface and subsoil drainage, on the whole, is rapid, even tends to be excessive over most of the area. The sandy, porous nature of the soil permits water to pass freely downward through the profile. Local drainage conditions, however, are influenced by the character of the underlying substratum and the depth of the soil. Pockets or small parcels of imperfectly to poorly drained land are to be found on the flat to depressional topography, particularly where the underlying substratum is formed of the clayey till which tends to restrict the downward movement of the water and to hold it unless the relief of the substratum permits lateral movement. These unfavourable drainage conditions, in some cases, may only be of a temporary nature and once the excess groundwater has drained away lack of moisture may be a limiting factor in crop production.

The present natural vegetation consists principally of young growth mixed-woods, with a thin covering of natural grasses in the uncultivated clearings and neglected fields.

Cultivated surface soils are usually light brown or greyish brown in colour, about 4 to 5 inches deep and low in organic-matter content. They are loose and porous with little or no structure. Where liberal applications of sea-weed, mussle-mud and other similar soil amendments have been applied in past years, the surface soil tends to be deeper, higher in organic-matter content, and less acid in reaction.

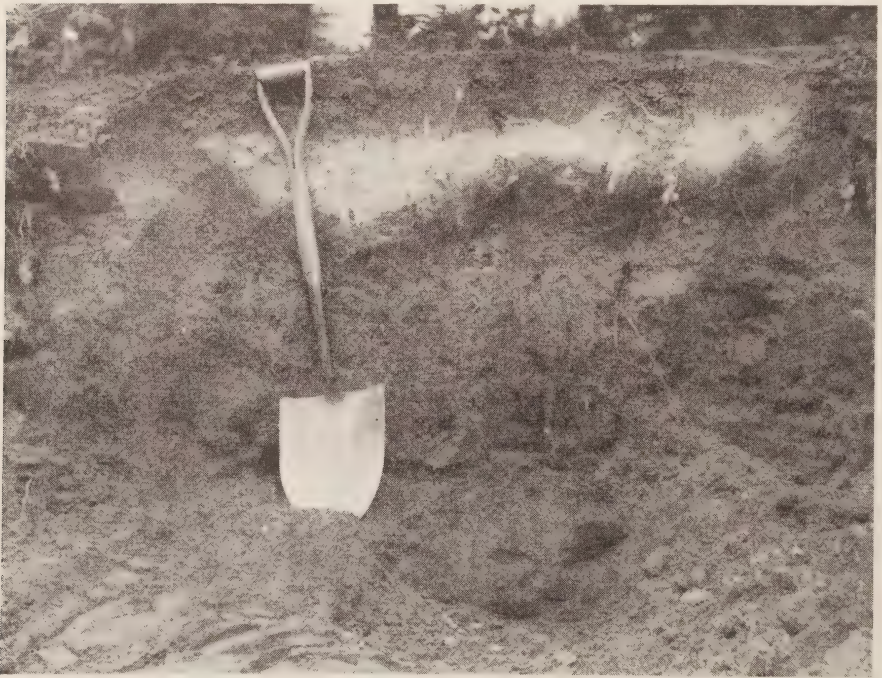


Fig. 12 Representative profile of Kildare sandy loam. Loose, porous, sandy soil underlain at about 3 feet by firm red sandstone till.

The subsoil, as a rule, is a loose, porous fine sand to light sandy loam which grades, at about 24 inches, into a loose sandy parent material. The parent material may or may not show feeble sorting.

Occasionally the upper part of the sub-soil, the B₁ horizon, may show a tendency to be weakly cemented, although seldom forming a definite hardpan or ortstein layer.

The thickness of the Kildare soils over the till or native rock varies from around 20 inches to 7 feet or more. These soils are potential blow-sands, especially on exposed positions on the more rolling topography.

The dominant texture of surface soils is loamy fine sand, although it may approach light fine sandy loam in places.

A representative description of a Kildare profile under young woods growth is as follows:

<i>Horizon</i>	<i>Thickness</i>	<i>Description</i>
A ₀	¼"	Dark brown, raw organic matter, mainly needle mould. Strongly acid. pH 5.4.
A ₁	½" to 1"	Dark brown or dark grey brown fine sandy loam. Structureless, loose and porous. High organic-matter content. Very strongly acid. pH 4.9.
A ₂	2" to 8"	Light ashy-grey loamy fine sand. Structureless, loose and porous. Has a faint pinkish cast. Very strongly acid. pH 5.0.
B ₁	8"	Brownish yellow fine sand. Structureless, loose and porous. Fairly high concentration of roots. Strongly acid. pH 5.2.
B ₂	10" to 12"	Light brownish red or reddish brown fine sand. Structureless, loose and porous. Strongly acid. pH 5.6.
C	Below 34"	Light brown, slight reddish cast, fine sand. Loose and porous. Weakly stratified. Practically gravel free. Some discoloration with black (carbonaceous) material. Strongly acid. pH 5.6.
D	At 5 feet.	Brownish red fine sandy loam to light sandy clay loam till.

In the more extensive areas the Kildare soils are fairly uniform, except for minor variations in colour, consistency and gravel content. In the case of colour and consistency these appear to be related to the origin of the rock material from which the parent material has been formed, whether micaceous or carbonaceous in character. In the Bideford area the texture is somewhat coarser than in general, with a slightly higher gravel content. Profile differentiation of the shallower deposits is often feeble and in the case of some of the small isolated areas the soil may suggest wind deposited sand spots. The included poorly drained soil usually has a darker surface layer resulting from the slightly higher accumulation of organic matter. The subsoil may not show a clear separation into sub-horizons, it is usually duller in colour, and may show slight mottling in the upper part. In some profiles a more or less definite layer distinguished by its strong mottling or dark colour caused by accumulation of infiltrated organic materials occurs between the ashy-grey A₂ layer and the subsoil layer.

Agriculture—Kildare soils are not highly developed, agriculturally. While a considerable proportion has been cleared only a small percentage is under cultivation. Most of the cleared land on the farms is used for hay and pasture. These, however, are not naturally good grassland soils and are considered to be marginal agricultural soils. The natural grass cover usually consists of a thin stand of indigenous species, such as brown top, which, as a rule, attain poor growth, mature early and provide only a short grazing period.

Mixed farming is practised on most farms. On some farms the growing of potatoes on a commercial scale provides the major source of income. Over most of the area, however, many of the farm owners are also fishermen and farming is a secondary industry.

The principal crops grown are oats, field roots—chiefly turnips, and timothy or timothy and clover hay; also, as previously mentioned, potatoes.

Under prevailing cultural practices yields generally are not high, oats around 25 bushels or less, per acre, and hay one ton or less, per acre. In seasons of ample moisture and under the better cultural practices some very satisfactory yields of grain and potatoes (up to 250 bushels or more of potatoes) have been obtained on Kildare soils, but hay and pasture yields generally are not satisfactory.

Owing to the physical character of the profile, its porosity and low clay and organic-matter contents, which give a low moisture-holding capacity, as well as to the naturally low level of plant nutrients, Kildare soils require intensive management in order to obtain maximum production and to maintain a satisfactory level of fertility.

Applications of chemical fertilizers have given good results, and their continued use will be necessary to supply the mineral elements, such as phosphorus and potash. Nevertheless, soil moisture conditions are a major factor in limiting crop production on these soils. In their management particular attention should be given to supplying organic matter to the soil, through the careful conservation and regular application of manure and other organic materials. It will also be necessary to apply liming materials to reduce the acidity or sourness of the soil.

MISCELLANEOUS LAND TYPES

ORGANIC SOILS

Organic soils consist of plant residues, in varying stages of decomposition, accumulated under poor drainage conditions in depressions and on the sites of old ponds and lakes. These deposits are commonly known as peat, muck or alder swamp or bog.

Approximately 9,790 acres, making up about 0.7 per cent of the total area, have been mapped in the province. It is not expected, however, that this figure accounts for all the organic soils that actually exist in the region. In the reconnaissance survey many of the smaller areas of muck and peat were not mapped out. Most of such areas are included with the poorly drained Armadale series.

The organic soils, as mapped, occur mainly in Kings and Prince counties, with the larger areas in the latter county. The individual areas range from less than an acre in size to 1,000 acres or more. The most extensive deposits are near Bideford (1,200 acres), at North Point (960 acres), in the Cascumpec Bay region, the "Black Banks" deposit (960 acres) and west of Miscouche (300-400 acres).

The depth of the organic deposits varies from 18 to 20 inches to 7 feet or more, with a total depth of 27 to 40 feet reported for the Bideford and "Black Banks" deposits. In most of the shallower deposits the organic layer is underlain by a fairly well developed profile with characteristics of the poorly drained soils in the surrounding area.

Organic soils are of two main classes, muck and peat. All of the organic soils examined are of the peat type. While no separations of the different peats have been mapped, three types were observed; namely, moss peat, woody peat, and sedge peat.

The character and composition of the different peats depends, mainly, upon the type of vegetation from which they are formed.

Moss Peat.—Formed principally from mosses, chiefly sphagnum. The more extensive areas usually exist as open treeless bogs, although some stunted larch and spruce may be growing on them. The vegetation on these bogs also includes heath, laurel, Labrador tea, blueberry, cranberry, cotton grasses and pitcher plant.

The organic accumulation on these open bogs tends to build up to a higher level at the centre than at the margins. Such deposits are often referred to as "High Moor".

The upper 2 to 6 feet of the peat, consist of raw, undecomposed sphagnum peat, brownish in colour. It is fibrous, slow to decompose, may be laminated or layered and is strongly acid in reaction. Below this the peat is felty in character, somewhat darker in colour and fibrous. At lower depths the peat is more highly decomposed, spongy and water-logged, and dark brown to black in colour.

The Bideford and "Black Banks" deposits are of the moss peat type.

Woody Peat.—As the name implies there is usually a noticeable amount of woody material as well as mosses in the make-up of this type of peat. The woody peats are associated with very poorly drained wooded areas. Much of the material is often coarse and only slightly decomposed, but the more finely disintegrated material is of a soft, somewhat greasy nature, tends to be crumbly when dry, but smeary and amorphous when wet. In places it has a slimy consistency. It is very dark brown to black in colour.

In some deposits the surface may be underlain by a dark brown felty peat, not so well decomposed, while in others the mineral soil immediately follows the mucky surface layer. Deposits of woody peat, often called muck or alder swamp, were frequently found surrounding or associated with small deposits of moss peat.

The North Point and Miscouche deposits are a combination of moss and woody peats.

Sedge Peat.—Usually occurs around the margins of ponds, sluggish streams and along the margin of salt marsh. The organic material consists principally of sedges, reeds and grasses. It is usually spongy and amorphous or structureless in character, and has a slimy or oozy consistency. As a rule this type of peat has a relatively high proportion of silty material.

The sedge peats or swampy-muck deposits generally are not very deep and are underlain by marsh-mud, alluvium or local till. Some of the deeper deposits may have a layer of raw sedge peat, greyish brown in colour.

Agriculture.—Except where organic soils occur as pockets or strips extending into cultivated fields, very little, if any, are under cultivation in Prince Edward Island.

While organic soils are well supplied with organic matter and total nitrogen, the organic matter, especially of the moss peats, is slow to decompose and the available nitrogen content generally is low. Mineral plant nutrients, such as lime, phosphoric acid and potash are also low, although lime and phosphoric acid are usually more available than potash. Organic soils generally are strongly acid in reaction. These deficiencies must be corrected before crops can be successfully grown on organic soils.

While plant nutrient levels are of paramount importance when considering the use of organic soils for the growing of crops there are a number of external factors that also need to be taken into consideration. These are, the character and depth of the material, the possibility of drainage, the cost of clearing and the availability of markets for the produce.

Of the different kinds of peat occurring in the province the woody peats are generally considered the most suitable for the growing of crops. Sedge peat may also have some value as pasture areas when drained and planted to reed canary grass.

Because of their raw fibrous character moss peats are not considered suitable for cultivation, although some of the shallower deposits where the surface layer of raw sphagnum is not too thick above the finely divided and closer textured material and can be readily cleared, may prove useful for cranberry growing.

Organic soils could be used to good advantage for the improvement of many mineral soils, particularly the lighter textured soils such as the Culloden and Kildare series.

Because of their relatively high capacity to absorb and retain water the addition of peat material to mineral soils will increase their moisture-holding capacity; and because of the slow rate of decomposition of peat soils they will help to maintain the organic-matter content of the mineral soils as well as having a beneficial effect upon tilth.

Other agricultural possibilities of organic soils are in the preparation of composts, in greenhouse work and as mulch for orchards and flower beds.

When using organic soils as amendments it will be desirable to apply lime to offset the acid reaction of the organic material added, and it will also be necessary to apply manure and chemical fertilizers to supply the plant nutrients that are lacking, as previously mentioned.

Organic soils, particularly the moss peats, have many commercial uses. Their development will depend to a large extent upon market and shipping facilities as well as ease of processing.

SALT MARSH

Salt marsh soils consist of fine sand, silty sand and silty clay sediments deposited by tidal and flood waters at scattered points around the coast and along the estuaries of the larger streams and rivers.

They occupy about 2,775 acres or 0.2 per cent of the total area.

The materials from which these soils are formed are the result of erosion activities and wastage of the surrounding upland soils and of the rock formations of the shoreline cliffs.

Drainage conditions are variable. In general the soils are poorly drained and are subject to repeated flooding and reworking by the daily tides and seasonal floods. As a result the profile shows no differentiation and the material is too variable to be classed as a definite soil series.

In the early years of settlement small areas along the upper reaches of the Hillsboro River had been dyked and reclaimed to provide hay and pasture land. The dykes, however, have been allowed to fall into disrepair. While a small amount of "marsh hay" may be cut on some of these soils, salt marsh has a low agricultural value and is classed as non-agricultural land. The natural vegetation is largely marsh grasses, sea-blite and spurrey.

DUNE SANDS

The dune sands are distributed around the coastal region, more particularly the north shore areas, facing the Gulf of St. Lawrence. They consist of material derived from the disintegration of the rocks of the surrounding cliffs and of alluvial material deposited by tidal action. These materials have been reworked by wind action to form dunes.

The dunes consist chiefly of fine sands, grey to pale yellow in colour, occasionally yellowish brown. Except for a slight variation in texture of the upper 6 to 12 inches, which tends to be a loamy fine sand, and a slight difference in shade of colour, there is no profile development. The soil mass is uniform to a depth of 25 feet or more.

While these deposits are subject to wind action and are known to change their position, locally, they have not encroached to any great extent upon the mainland areas. In some cases the adjacent upland soils show a very thin deposit of the drift sand on the surface.

The dune sands carry a sparse cover of coarse grasses and other salt-tolerant plants, among them are sand-pea, saltwort, sand grass and sea rocket. This thin vegetative cover has helped to some extent to stabilize these soils.

The dune deposits have no agricultural value, being non-arable soil, and they are of minor extent occupying approximately 7,000 acres or 0.5 per cent of the total area.



Fig. 13 Typical sand dune with sparse vegetative cover.

Composition of Prince Edward Island Soils

While the analytical data presented in tables 16 to 21, (in the appendix), are insufficient to give a complete picture of the composition of the soils of the province, they will serve to indicate the relative textures, as shown by the percentages of sand, silt and clay (tables 16 and 17), also the general fertility levels as indicated by the levels of available plant nutrients and the exchangeable bases (tables 18 to 21).

Mechanical Analysis.—A characteristic of Prince Edward Island soils is the tendency of the surface soils to form small, weak clods which give to the soil the appearance of being heavier than is actually the case. This is more particularly noticeable in the lighter textured soils. Another characteristic is the greasy or slippery consistency of the soils when wet, a condition readily recognized by all who have driven over the dirt roads following a rain.

As will be seen from the data in tables 16 and 17, the percentages of fine sand particles are relatively high, particularly in the lighter soils. As a consequence most of the soils can be classed as fine sandy loam. The percentages of silt, as compared with clay are also relatively high. While this is not so

marked in the case of the heavier soils there is a similar trend. It is to the silt particles that the characteristics previously noted may be largely attributed. Silt in quantity imparts a smooth or soapy consistency to a soil and by reason of the tendency of silt particles to coalesce when moist, the soil may assume some of the physical characteristics of a clay soil.

Many of the soils of the Island, and more especially the subsoils, are commonly called clay soils. To be classed as a clay the soil must contain 30 per cent or more of clay particles. The data in table 16 indicate that only one soil series, the Egmont series, may be correctly classed as clay.

The physical composition of the soil serves as a measure of the moisture-holding capacity. The ability of a soil to hold moisture is a function of the clay fraction, as well as of the soil organic matter. The percentages of clay given for the Kildare and Culloden soils would indicate a low moisture-holding capacity. This is confirmed by the field behaviour—crops on these two soils often suffer from lack of sufficient moisture for crop growth during the drier seasons.

Chemical Composition.—Tables 18 to 21 give some data on the chemical composition of representative profiles of the main soil associations. The figures show that in general the natural fertility of Prince Edward Island soils is not high and that they are strongly acid throughout the profile, with pH values of 3.8 to 4.8 in the surface layers, and 4.7 to 5.6 in the subsoil. The Egmont soils are the exception. The total nitrogen content, percentage of exchangeable bases, as well as the more favourable pH values in the subsoil ("B" Horizon) and the parent material ("C" Horizon) of this series, indicating slightly acid to neutral conditions, suggest a higher level of natural fertility for the Egmont soils than is common to most of the Island soils. Drainage conditions, however, reduce their agricultural utilization.

The organic-matter content of the Island soils is characteristic of Podzol soils, namely a relatively high amount on the surface but of a low order through the profile. The data in Column 1, table 21, indicate that the organic-matter content of cultivated soils generally is not being maintained at as high a level as could be desired for proper soil conservation.

Tables 19 and 20 serve to provide a more practical interpretation of the chemical data. These tables give the readily available plant nutrient levels and amounts of replaceable calcium, magnesium, potash and total nitrogen available for plant growth, expressed as pounds per acre.

Considering 4,000 lb. of total nitrogen, 200 lb. of available phosphorous and 160 lb. of potash per acre as necessary to a well supplied soil it will be apparent Prince Edward Island soils do not meet these requirements.

An expression frequently heard is "The soils are becoming run-out", and as a result are more acid. The acid condition of the Island soils is a natural characteristic resulting from several factors, among them low content of calcium or lime. The low calcium content and the strongly acid reaction throughout the profile are factors that will need to be considered in any soil fertility program.

Potatoes which form a major crop of the area require relatively high amounts of magnesium for proper growth. It is therefore interesting to note that the soils, under natural conditions, are reasonably well supplied. The figures for magnesium, however, in table 21 suggest that present cultural practices are adversely affecting the magnesium supply and can be expected to result in a magnesium deficiency in the soils of the extensive potato growing areas.

AGRICULTURE AND UTILIZATION OF SOILS

Agricultural Development

The history of agricultural development in Prince Edward Island covers a period of approximately 200 years, beginning with the settlement in 1728, of Acadian-French farmers from Nova Scotia.

Following their traditional custom of settling along the rivers and bays the Acadians reclaimed the salt marsh areas and cleared the adjacent forested uplands. During the period of the French regime, between the years 1713 to 1763, approximately 10,900 acres of land were reclaimed or cleared and brought under cultivation. The type of agriculture practised was a primitive mixed-farming type, concerned primarily with supplying the needs of the settlers and of the French garrisons stationed at Louisbourg and Quebec. The principal crops grown were wheat and peas. Early records show that in 1739 about 699 bushels of wheat and 150 bushels of peas were planted which yielded 9 to 1, and the livestock population was 433 head of cattle and 190 sheep.

After the province was transferred to British rule a second period in agricultural development began with the arrival of settlers of British and United Empire Loyalist stock. The progress of development during this period, approximately 100 years, was to a large extent influenced by the system of land tenure in force. It has been stated in the section on Organization (p. 8) that the province had been divided into 67 lots. These lots had been granted to a group of individuals in Britain on terms requiring them to settle and develop their several estates. A system of lease-hold land-tenure was established, the settlers holding their farms at rentals of 1 to 3 shillings per acre. This system of land tenure continued until 1875, three years after Confederation, when, under the authority of the Land Act of 1875 the government bought the lands of the absentee landlords and resold it to the settlers, enabling them to obtain freehold title to their farms. Although the system of leasehold proved unsatisfactory and is considered to have delayed settlement and development—for instance, in 1797 there were 23 lots, about 500,000 acres, without settlers and another 18 lots with a total population of 86 families—the rate of clearing land progressed rapidly. During the 40-year period 1841-1881, the total acreage of cleared land increased 300 per cent with 100 per cent increase in improved land per farm.

TABLE 8.—ACREAGE OF IMPROVED LAND, TOTAL AREA, AND ACRES PER FARM, 1841-1941, SHOWING PROGRESS IN DEVELOPMENT OF FARMS (1)

—	1841	1861	1871	1881	1891	1901	1911	1921	1931	1941
Total Improved Area.....	141,580	368,127	445,103	596,731	718,092	726,285	769,140	767,319	765,772	737,390
Acreage per Farm, Total.....	97	90	89	83	80	87	85	89	93	96
Acreage per Farm, Improved.....	22	34	39	44	47	53	54	56	60	60

(1) Economic Survey of Prince Edward Island—J. E. Lattimer, Department of Reconstruction, Prince Edward Island, 1944.

While the new settlers of this period introduced improved livestock and seed, as well as new farming methods, including the Scottish seven-year rotation of grain, hoed crop, grain, 2 years hay and 2 years pasture, the general trend of farming practices was one of exploitation of the land resources. Agriculture in the early years was necessarily of a lumbering-farming type. Oats and hay were the principal crops grown; other crops planted were wheat, barley and potatoes. As the land was cleared oats and hay were grown exten-

sively for export. Large quantities were shipped to Great Britain and America, the trade with the Northern States expanding rapidly during the period of the American Civil War, 1860-1864. As a consequence, a considerable acreage of marginal land was cleared and brought under cultivation. Oats were grown repeatedly on many fields with little or no return of manuring materials to the land, the inevitable results of such a system of farming followed, loss of soil fertility and decreasing yields.

After the year 1875 the rate of settlement increased and an improvement in farming methods began to take place. This latter trend was partly influenced by the fall in the price of oats, consequent upon the ending of the Civil War, coupled with the lessening yields and in part by the development of the American and Canadian West. Towards the close of the 19th Century the rate of land clearing decreased, yet the size of farms increased. This latter trend has continued, due mainly to the decrease in the number of farms through the combining of small units. Table 9 shows the trend in the size of farms during the 40-year period, 1901-1941. It will be noted that during the last 30 years, the number of farms 100 acres or less has decreased between 15 to 30 per cent while the number of farms 200 acres or more has increased about 20 per cent. The average size of farm is 95.6 acres.

TABLE 9.—FARM HOLDINGS CLASSIFIED BY SIZE OF FARM, PRINCE EDWARD ISLAND, 1901-1941. (Census 1941)

Size of Farm	1901	1911	1921	1931	1941
All Farms.....	13,748	14,113	13,701	12,865	12,230
1 to 4 acres.....	599	606	332	333	192
5 to 10 acres.....	389	422	397	357	358
11 to 50 acres.....	3,769	3,849	3,526	3,052	2,878
51 to 100 acres.....	5,380	5,495	5,568	5,071	4,696
101 to 200 acres.....	3,030	3,227	3,328	3,418	3,412
201 and over.....	581	514	550	634	694

This change in size of farms has resulted in a change in the condition of the land, as shown in table 10. A slight decrease has occurred in the area occupied by farms, due largely to the growth of urban population. The table also shows that although the acreage of improved land and the crop acreage have increased there has been an increase in the area of woodland partly because areas of marginal land once under cultivation have been allowed to revert to the natural vegetation.

TABLE 10.—ACREAGE AND CONDITION OF LAND IN PRINCE EDWARD ISLAND (1941 Census)

	1881	1911	1941
Total Land Area.....	1,397,760	1,397,760	1,397,760
Area Occupied by Farms.....	1,126,653	1,202,354	1,118,868
Area of Improved Land.....	596,731	769,140	737,400
Pasture.....	—	—	237,062
All Crops.....	469,796	488,746	523,962
Other Improved Land.....	—	—	26,044
Area of Unimproved Land.....	529,922	433,214	431,468
Woodland.....	—	307,974	315,780
Natural Grass.....	—	105,026	80,604
Marsh or Waste Land.....	—	20,214	35,084
Total Number of Farms.....	13,629	14,113	12,230
Average size of Farm.....	82.7	85.2	95.6
Per cent of Total Area in Farms.....	80.6	86.0	83.6
Improved Land per Farm.....	43.8	54.0	60.3
Unimproved Land per Farm.....	38.9	31.0	35.3
Average Area of Woodland per Farm.....	—	22.3	25.8

With the decline in the popularity of growing oats and hay for export a trend towards dairy farming developed. The first cheese and butter factories were established in 1883 and 1887 respectively. Dairying became established as a main agricultural industry about the year 1891 with 11 cheese and butter factories in operation.

In the early years of the change cheese production held an important place. Many cheese factories were operating throughout the province. With the steady fall in cheese prices since the 1920's, cheese production has given place to cream and butter production, creameries have replaced many of the cheese factories, and with the development of urban centres a local fluid-milk market has developed. The numbers of dairy processing plants in 1946, as given in the Annual Report of the Provincial Department of Agriculture, are: butter factories 16, cheese factories 8, and milk plants 8.

The change in type of farming brought many changes in farming methods, a greater increase in the improvement of livestock, the replacing of the Scottish seven-year rotation with a 4- or 5-year rotation to meet the requirement of more fodder for livestock, increased use of fertilizers and soil amendments and the growth of specialization.

Table 11 shows the trend in crop production since the turn of the century. The acreage in wheat and oats has decreased, the decrease in wheat has been sharp. Barley and mixed grains have increased rapidly, particularly so in respect to mixed grains since 1931, which, incidentally, coincides with the rapid increase in the number of swine and poultry during the same period. Field roots and cultivated hay have shown a steady increase.

TABLE 11.—ACREAGE OF PRINCIPAL CROPS IN PRINCE EDWARD ISLAND, 1900 TO 1941 AND IN 1946 WITH YIELDS PER ACRE.⁽¹⁾

—	1900	1911	1921	1931	1941	1946	Average yield per acre 1900-1941	1946
All Field Crops....	447,737	484,274	458,644	694,692	467,744	475,700	—	—
Wheat.....	42,318	31,105	26,828	20,032	9,764	3,900	—	20 bu.
Barley.....	4,563	4,628	4,056	3,775	13,409	9,700	25 bu.	27 bu.
Oats.....	164,472	180,584	162,625	148,817	128,202	116,800	30 bu.	34 bu.
Buckwheat.....	2,993	2,794	1,756	1,869	1,441	1,200	20 bu.	20 bu.
Mixed Grains.....	6,788	7,693	9,939	20,814	33,714	51,400	32 bu.	36 bu.
Potatoes.....	33,405	30,780	31,716	53,815	40,300	49,000	172 bu.	195 bu.
Cultivated Hay....	181,996	217,224	212,207	235,022	228,220	231,000	1.4 ton	0.5 ton
Field Roots.....	8,905	7,969	7,859	8,268	10,958	11,700	205 cwt.	15.6 ton
Pasture.....	—	—	252,335	242,195	237,195	—	—	—

(¹) Dominion Census.

The potato acreage remained steady between the years 1900-1921, a rapid increase occurred during the next 10 years, with 1931 the peak year. This was followed by a sharp decrease due in part to the low prices resulting from the depression and to other factors, such as curtailed export market and tariffs.

Prior to 1918 practically all the potatoes were grown and marketed as "table stock". In the year 1918 about 50 acres were grown for certified seed and that year the first carload of Prince Edward Island certified seed potatoes was shipped. The seed potato industry has become a major factor in the economy of the province; in 1946 approximately 2 $\frac{3}{4}$ million bushels of seed potatoes were exported. The Island, with its high reputation as a disease-free area for seed potatoes and having a high standard of requirement for certification, has become the principal certified seed potato producing area in Canada.

Of the 49,000 acres planted to potatoes in 1946, approximately 36,000 acres were for certified seed alone; this is more than the total acreage in any year between 1900 and 1921.

Within the last 15 years there has been a revival of interest in tree and small fruits production, although the actual acreage of tree fruits was smaller in 1941 than in 1931, because of heavy losses sustained as a result of the severe winter in 1930-31. Strawberry plantings have greatly increased during the last few years and there is a developing interest in cranberry and blueberry culture. The growing of vegetables for the canning industry, also for seed production, and more recently cucumbers for the pickling trade, are specialized types of farming being developed in some sections of the province. The area under cucumbers alone is approximately 700 acres.

The livestock population per farm, as determined from the 1946 census figures (table 12), is approximately 23 head, not including poultry, and the average number of milch cows per farm is eight. As will be seen in the table, milch cows make up nearly half the number of cattle on the Island, indicating a dairy type of agriculture. There are many excellent herds of purebred Holstein, Guernsey, Ayrshire and Jersey cattle, with many of the grade herds of high quality. The most popular breed of beef cattle is the Shorthorn although Herefords and Aberdeen-Angus are also represented.

The number of cattle has remained fairly constant, particularly the number of milch cows. The decrease in other cattle since the 1911-1921 period is due largely to market conditions.

Swine production provides an important source of income on many farms. The approximate annual production is about 100,000 of which about 65,000 are marketed through packing plants. Only one breed is maintained, Yorkshire. This fact, coupled with careful attention to breeding and rigid selection, has resulted in the production of high quality hogs which has placed the province in a leading position with regard to the percentage of top grade commercial hogs marketed, approximately 50 per cent.

While sheep raising holds an important place in many communities the sheep population has decreased rapidly. This is largely because of low prices, growth of the dairy industry, increased acreage of improved arable land, and since 1920, rapid increase in the potato industry.

The increase in the number of poultry has resulted from an increase in the number and size of farm flocks rather than from the development of specialized poultry farms, of which there are only 12 in the province. There are 10 commercial chick hatcheries, from which 538,285 day-old chicks were distributed throughout the province in 1946. There are also 6 poultry canning plants and 60 egg grading stations.⁽¹⁾ The total egg production has increased rapidly since 1939, from 2,995,000 dozens to 6 million dozens in 1946, and the total annual value of all poultry products is approximately 2 million dollars. ⁽²⁾

TABLE 12.—LIVESTOCK POPULATION, P.E.I.
(Dominion Census 1941-1946)

—	1881	1891	1901	1911	1921	1931	1941	1946
Horses	31,335	37,392	33,731	35,935	32,961	30,709	28,359	25,450
Cows.....	⁽³⁾ 45,895	45,849	56,437	52,109	48,950	45,241	⁽⁴⁾ 47,102	45,800
Other Cattle.....	42,827	45,846	56,341	61,334	62,054	56,142	48,252	56,200
Sheep.....	166,496	147,372	125,546	91,232	105,884	78,475	44,269	51,100
Swine.....	40,181	42,629	48,007	56,377	39,675	41,322	48,882	105,000
Poultry.....	—	534,962	581,790	760,939	869,064	954,993	938,207	1,154,000

(1) Annual Report, Provincial Department of Agriculture.

(2) Information supplied by Poultry Promotion Service, Dominion Department of Agriculture, Charlottetown.

(3) From 1881 to 1941 this item was "milch cows".

(4) Cows and Heifers 2 years old and over, kept for milk and milk production.

Land-Use Classification and Soil Rating

While it is not possible, from a reconnaissance survey, to accurately assess land use suitability or to give detailed recommendations for the proper utilization of the different soils, the information obtained from the soil survey of the province makes possible a tentative land-use classification. This classification is subject to revision as more detailed information regarding the requirements and the productivity of the soils is acquired. It is based upon soil profile characteristics, particularly texture; upon the nature of the topography and natural drainage conditions, as well as upon erodibility, and on the suitability of the soils to produce the crops commonly grown in the province.

Soil texture and also structure are important factors in the utilization of soils. They determine the permeability of the soil and also influence moisture relationships and workability as well as the susceptibility of the soil to erosion.

The nature of the surface relief or topography influences soil moisture conditions and soil temperatures as well as the erodibility of the soil. Consequently it is a factor in determining the suitability of the land for different crops. The character of the topography also determines, in part, the types of farm machinery to be used and the power needed to operate them.

Drainage, closely linked with topography, also affects soil moisture relationships which in turn influence the ability of plants to maintain themselves, as well as influencing the kind of plants to be grown and the soil management practices to be followed.

Land-Use Groups

Six Land-Use groups are suggested for Prince Edward Island, the approximate location of the larger areas are shown in Fig. 14.

LAND-USE—GROUP 1

<i>Soil Series</i>	<i>Acres</i>	<i>Per cent of total area</i>
Alberry	270,410	19·7
Charlottetown	443,370	32·4
O'Leary	62,605	4·6
	<u>776,385</u>	<u>56·7</u>

The soils included in Group 1 consist of the better agricultural and potential agricultural land. The greater proportion of the soils in the group are under cultivation. They are well suited to a wide variety of crops and are capable of producing good yields of the crops generally grown in the region.

Surface relief is nearly level to strongly undulating, permitting the use of all types of farm machinery. Soil erosion should not be a serious factor provided good management practices are followed. It will occur, however, under certain conditions of management and seasonal climate.

The O'Leary soils can be expected to have a slight superiority for grassland although they have not quite so wide a range in crop adaptability.

While the natural fertility of this group is not high, costs of production and soil conservation measures will be less than for other soils of the province.

LAND-USE—GROUP 2

<i>Soil Series</i>	<i>Acres</i>	<i>Per cent of total area</i>
Haliburton	27,340	2·0
Pownall	4,900	0·4
Queens	3,200	0·2
	<u>35,440</u>	<u>2·6</u>

These are good to fair agricultural soils. They have a slightly lower rating than the soils in Group 1, because soil moisture relationships in general, are not quite so good.

All the soils of this group are capable of producing good yields but are more restricted in their crop adaptability than Group 1.

Owing to the somewhat porous nature of the Haliburton soils, lack of a sufficient moisture supply during the growing season may be a serious factor in reducing crop yields. They are not high yielding grasslands but are better suited to potatoes than the other soils in this group.

Seasonal excess of moisture is a factor to be considered in the case of the Pownall and Queens soils. While drainage is not a serious problem some simple drainage system would be beneficial. The Pownall and Queens soils are well suited to grass and other general farm crops but are marginal potato soils.

Soil erosion should not be a serious factor on the soils of this group. The texture of the Haliburton and Queens soils however, coupled with the undulating character of the topography, causes them to be susceptible to erosion damage where management is neglected.

LAND-USE—GROUP 3

<i>Soil Series</i>	<i>Acres</i>	<i>Per cent of total area</i>
Culloden	177,655	13·0
Kildare	18,210	1·3
	<u>195,865</u>	<u>14·3</u>

Soils in Group 3 are fair to marginal agricultural land, unfavourable soil moisture conditions being the limiting factor. The light texture and porosity of the profile cause these soils to have a low moisture-holding capacity. Although they are capable of producing fair yields of grain and moderately good yields of potatoes under good management the soils of this group can only be classed as marginal grasslands.

The agricultural value and the productivity of these soils will be determined largely by their utilization—type of farming followed, kind of crops grown, intensity of soil management practices and availability of markets to justify specialization.

Soil erosion may be severe on the Culloden series, especially on the rolling topography. Costs of production and soil conservation measures will be relatively high.

LAND-USE—GROUP 4

<i>Soil Series</i>	<i>Acres</i>	<i>Per cent of total area</i>
Alberry } Rolling phase {	41,400	3·2
Charlottetown }	40,600	2·8
Egmont	59,180	4·3
	<u>141,180</u>	<u>10·3</u>

Soils in this group are marginal for agriculture because of the nature of topography, erodibility and poor natural drainage conditions. The rolling character of the topography of the areas of the Charlottetown and Alberry series included in this group increases their erodibility. Where these soils are under cultivation special conservation practices are essential. Maintaining a large proportion of these soils under grass and preferably forest would be desirable.

Poor natural drainage conditions limit the agricultural utilization of the Egmont soils. Systematic drainage will be necessary to increase their agricultural value. They are potential grassland soils, mostly under forest cover at present.

LAND - USE GROUPS

LAND-USE GROUP	1	2	3	4	5	6
"	"	"	"	"	"	"
"	"	"	"	"	"	"
"	"	"	"	"	"	"
"	"	"	"	"	"	"
"	"	"	"	"	"	"



LAND-USE—GROUP 5

<i>Soil Series</i>	<i>Acres</i>	<i>Per cent of total area</i>
Dunstaffnage	33,865	2.5
Armadales	141,760	10.4
	<u>175,625</u>	<u>12.9</u>

These are submarginal lands. Unfavourable profile characteristics, coupled with the nature of the topography, give rise to extremes in drainage conditions.

Dunstaffnage soils are coarse textured and porous, developed from sorted sandy, gravelly and cobbly outwash material on kames and eskers. They are excessively drained to droughty soils. Where cleared they support poor natural grass and even under good management crop yields are only fair to poor. Much of the formerly cleared land is now reverting to blueberry barrens and woods.

Owing to the more or less impervious nature of the subsoil, coupled with the nearly level topography and lack of natural drainage outlets, Armadales soils are poorly drained. They are mainly under forest cover.

LAND-USE—GROUP 6

<i>Soil Series</i>	<i>Acres</i>	<i>Per cent of total area</i>
Alberry	6,500	0.5
Charlottetown	2,100	0.2
Culloden	15,310	1.1
Peat	9,790	0.7
Salt Marsh	2,775	0.2
Dune Sand	7,020	0.5
	<u>43,495</u>	<u>3.2</u>

This group represents non-agricultural land. Extremes in topography, unfavourable natural drainage conditions and susceptibility to severe erosion, together with high costs of reclamation and maintenance restrict the agricultural use of these areas.

The figures given in the foregoing table indicate that approximately 59.3 per cent (Groups 1 and 2) of the total area is well suited to agricultural use, having a wide range in crop adaptability and capable of producing good yields under reasonable management practices. Another 24.6 per cent of the area (Groups 3 and 4) is shown to be suitable for agricultural purposes, but with a narrower range in crop adaptation, and provided special measures are taken both as regards the selection of crops, type of farming and soil management practices. Without such special measures much of the land included in these land-use groups might better be under forest cover. The remaining 16.0 per cent of the land may be considered as being better suited to forest vegetation and valuable as a source of timber, as reservoirs for water conservation and as having possible uses for recreational purposes.

Preliminary studies correlating the distribution of soil types as mapped, with the percentage of improved land and total revenue per acre, as determined by the Agricultural Statistics Branch,⁽¹⁾ indicate that in the sections of the province where the soils of Groups 1 and 2 are dominant, the percentage of improved and cropped land per farm is higher than on soils of Groups 3 and 4, (approximately 65 and 71 per cent as compared with 49 and 47 per cent), while the total farm revenue per acre is approximately 40 per cent higher.

⁽¹⁾ Information supplied privately through the courtesy of Dr. S. C. Hudson, Agr. Econ. Div., Marketing Service, Dom. Dept. Agr., Canada.

The most reliable measure of the suitability of a soil for agricultural purposes is its capacity to produce crops. In table 13 a tentative rating of the suitability of the various soils for the principal crops grown in the province is given. In the absence of authentic yield data for individual soil series, the ratings are, of necessity, only estimates based upon the soil characteristics as observed in the field, on general observations of crop growth and upon estimates obtained from farmers, supplemented by such yield data as are available.

In presenting this rating it is assumed that a reasonably good soil management program is followed. The soil management practices on the individual farm will greatly influence the productivity of the soil. A soil rated as highly favourable for a given crop may, under poor management, produce no better yields than another soil rated as favourable or marginal for the same crop. For instance, yields of 60 bushels of oats and 2 to 3 tons per acre of good quality hay, including alfalfa, have been obtained on the Charlottetown soils under good management. Under less favourable systems of management yields around 30 bushels of grain and 1 ton or less of poor quality hay, are more common. On the other hand, the productivity of a marginal soil, such as the Culloden series, may be greatly improved by proper cultural practices, as shown by yields of 243 bushels of potatoes when manure and fertilizer are applied as compared with 135.7 bushels without.⁽¹⁾

TABLE 13.—SOIL RATING FOR THE PRINCIPAL CROPS GROWN IN THE PROVINCE

Soil Series	Grain	Potatoes	Hay or grass	Field roots	Land use group
<i>Good Crop Land—</i>					
Alberry.....	F	H F	F	F	1
Charlottetown.....	H F	H F	F	F	1
O'Leary.....	H F	F	H F	F	1
Haliburton.....	F-M	F	F-M	F	2
Pownall.....	F	M	H F	F	2
Queens.....	F	M	H F	F	2
<i>Fair to Marginal Crop Land—</i>					
Culloden.....	M	F-H F	M	M	3
Kildare.....	M	F	M	M	3
<i>Marginal Crop Land—</i>					
Alberry.....	Slope { Phase {	M	F	M	4
Charlottetown.....		M	F	M	4
Egmont.....		U	F	M	4
Dunstaffnage.....		M	M-U	U	5

Symbols: H F Highly Favourable
F Favourable
M Marginal
U Unsuitable

This soil-crop rating shows agreement with respect to crop adaptability of the different soils as expressed in the land-use grouping. While it is only an estimate, the table serves to indicate the relation between the nature of the soil and the type of farming or the kind of crops that may be expected to be successful on the different soils of the province.

Soil Management

While the nature of the soil, that is, the physical and chemical characteristics, is of fundamental importance in assessing its agricultural value and utilization, and in determining the type of farming to be followed, as well as

⁽¹⁾ Progress Report, Illustration Stations, Dominion Department of Agriculture, 1931-1933.

the kind of crops to be grown, the soil management practices will modify, constructively or otherwise the natural soil effects. They will also greatly influence the productive capacity and longevity of the soil as an economical unit of production.

In the preceding sections of this report descriptions of the different soil units forming the soil pattern of Prince Edward Island have been given along with a brief discussion of the factors responsible for their development and which also influence their capacity to withstand the demands of agricultural production.

Once the land has been cleared of its original vegetation and brought under cultivation, many changes begin. The soil is exposed to the pulverizing effects of weathering and tillage implements which tend to modify the physical characteristics of the surface layer. The influence of the natural agencies of soil conservation, namely the cycle of vegetative growth and decay are interrupted with the growing and removal of crops—particularly when they are sold directly off the farm. Some of the elements of soil fertility are depleted by intensive cropping and soil deterioration begins.

Soil deterioration may not be evident for many years. It is not generally recognized until the loss of soil due to erosion has become very obvious, or the decline in crop yields, as measurable from the need of application of increasing amounts of fertilizers, has become very marked.

Soil impoverishment invariably accompanies man's use of the land unless the management practices followed are fundamentally sound. The soil management program should be planned with the objective of maintaining, and where possible, improving, the level of available plant food, and of preserving the physical condition. In other words it should aim at the conservation of soil fertility with a view to maintaining, economically, a continuing high level of productivity.



Fig. 15 Plantation of pine seedlings on Culloden-Dunstaffnage soil area at the Illustration Station near Alliston. The reforestation of droughty or severely eroded soils, low in fertility, is good practice.

Many soil problems will be encountered. In Prince Edward Island the major soil problems are low natural soil fertility, excessive acidity, the erodibility of the soils, and unsatisfactory soil moisture conditions. The latter occur in the areas where the groundwater supply is excessive, or in the areas where the moisture-holding capacity is low and the soils tend to be droughty during much of the growing season.

The low soil fertility is of first importance. It is common to all soils of the province as a result of the climatic conditions and the nature of parent materials which encourage severe leaching, as well as to the effects of the cultural practices followed since the land was brought under cultivation.

The system of management on most farms, on all the different types of soil, usually provides for a 5- to 6-year rotation consisting of a hoed crop, potatoes or field roots, grain, clover hay, timothy hay and pasture. There are of necessity many variations. On some of the specialized potato farms, where no livestock are kept, a three-year rotation of potatoes, grain and hay is frequently practised. The hay is used, more or less, as a green manuring crop to provide organic matter rather than as a crop to be harvested. On the more highly developed livestock and dairy farms potatoes are not usually grown in any large quantity, while on the majority of farms where the enterprise is a compromise between potato growing and dairy or livestock farming the cropping system may be more irregular.

In general, barnyard manure is in short supply on most farms. As a rule it is applied to meet the requirements of the hoed crop with any surplus being used for top dressing grain or grasslands. On the specialized potato farms, or where potatoes form an important item in the rotation, large quantities of commercial fertilizers are used, applications ranging from 1,800 to 2,500 lb. per acre of such mixtures as 4-8-10 and 5-10-10. For grain 300 to 500 lb. of 3-15-6, or 4-12-6 are common rates and mixtures, where fertilizer is applied. For top dressing hay or pasture land 100 to 125 lb. of a nitrogenous fertilizer such as calcium cyanamide or ammonium nitrate is used, or a complete mixture like a 3-15-6, 4-12-6 or 5-10-10 may be applied in amounts varying from 500 to 1,000 lb. per acre.

From observations during the course of the survey a number of facts relative to the fertility of the soil were apparent. First, the soil structure in general is poor—it lacks the desirable crumbly condition indicating good tilth. Secondly, the soil organic-matter content, on the whole, is at a low level. This is reflected by the poor structure, the tendency of surface layers to become crusty, the light colour of the surface soil, and in part, by the rapidity with which the surface soils dry out. Thirdly, the condition of the soil is strongly acid, not only the surface layers but also the subsoils and parent materials, as shown by numerous field tests and laboratory determinations. (tables 15-21 in Appendix)

Laboratory determinations of a large number of surface soils show that between 50 and 60 per cent are in the strongly acid class, with 10 to 15 per cent slightly acid or better. It was however, noted that on land where the practice of applying "mussel-mud" had been followed in earlier years the soil reaction, invariably, was medium to slightly acid, pH 5.8 to 6.6. The data in table 14 indicate the effect of liming materials on soil reaction, as determined on 400 representative surface soils.

TABLE 14.—EFFECT OF LIMING MATERIALS ON SOIL REACTION.
(PER CENT DISTRIBUTION OF SAMPLES IN EACH REACTION GROUP)

Reaction Range	Mussel-mud	Limed	None
Extremely acid, pH. 4.8 or less	4.0	1.7	7.3
Strongly acid, pH. 5.0 to 5.4.....	30.0	35.6	52.7
Medium acid, pH. 5.6 to 6.2.....	45.0	39.0	31.8
Slightly acid, pH. 6.4 to 6.8.....	21.0	23.7	8.2

It should be stated that the use of mussel-mud, a combination of river or marine silt and shell deposits—chiefly oyster-shell, has not been followed during the past 12 to 15 years. Consequently, the present-day effect is residual from applications made 20 to 40 years ago, whereas the applications of limestone have been more recent. Field observations also indicated that the mussel-mud not only provides a continuing supply of available calcium but it is also distributed deeper in the soil than is general where lime has been used.

The use of liming materials is of importance in the province, both with respect to the growing of potatoes and in the maintenance of grasslands. Since the critical pH for the production of scab-free potatoes is generally considered to be around pH 5.4 it will be obvious there is a hazard in planting potatoes in "mudded" land. On the other hand in Prince Edward Island the soil reaction, generally, is more strongly acid than the optimum tolerance of many of the better species of grasses for satisfactory growth, not to mention the very desirable legumes.

A sufficient supply of calcium (lime) is required to correct the acidity of the soil, and is also necessary for plant growth, especially legumes, but too high a level of available calcium may prove injurious to the potato crop by reason of encouraging the development of scab (*Actinomyces scabies*). Therefore, the use of liming materials in the soil management practices in the province will require careful consideration. On land that has been "mudded" the use of agricultural limestone is not usually necessary. The experience of farmers has been that mudded soils show little, if any, response to applications of limestone. On the more acid soils, where potatoes are not included in the rotation agricultural limestone can be regularly applied, in the rotation, at rates up to 2 tons per acre. On the specialized potato farms or where potatoes are an important crop in the rotation, not more than 1 ton of lime per acre should be used.

In the matter of applying liming materials to the soil consideration should also be given to the necessity for supplying magnesium. While magnesium is usually considered to be one of the minor plant nutrients because only relatively small amounts are required by plants, and soils normally are well supplied with this element, the supply of available magnesium may be rapidly depleted in potato growing areas. Laboratory determinations indicate about 35 per cent of the Island soils are low in readily available magnesium. The lack of this plant nutrient can be corrected by using dolomitic limestone or by using potato fertilizer mixtures containing magnesia; the latter would probably be the safer source of supply for "mudded" soils.

A comparison of the data given in tables 19, 20, 21 show in a general way the effect of prevailing cultural practices on the level of available plant nutrients. The data given in table 15 will serve to indicate, in more detail, the effect of different manurial practices on several soil types and under different crops.

TABLE 15.—CHEMICAL COMPOSITION (AVERAGE) OF 37 REPRESENTATIVE CULTIVATED SURFACE SOILS, UNDER DIFFERENT CROPS AND MANURIAL TREATMENT

Soil Series	Number of Samples	pH	Organic Matter %	Hyg. Moisture %	Total Nitrogen %	Readily Available Nutrients (Morgan Method)				Crop	Treatment during Current Cropping Year
						Nitrogen Range	Phosphorous Range	Potash Range	Calcium Range	Magnesium Range	
Charlottetown.....	3 3 5 5	6.2 5.9 6.1 5.6	2.5 3.0 3.0 2.5	1.4 1.7 1.4 1.5	0.17 0.18 0.15 0.16	L L- M+ MH+	L+ L+ L+ MH	VL M- L+ M-	H+ MH+ H+ MH+	H- H- MH+ MH-	None Hay None Pasture Potatoes Chemical fertilizers only (4-8-10, 5-10-10 or equivalent).
Average.....	16	5.9	2.7	1.5	0.17	M-	M-	L-	H-	MH+	All treatments.
Alberry.....	2 3 3	5.9 6.3 5.9	2.5 1.8 3.3	1.2 1.3 1.7	0.14 0.14 0.19	VL MH- H+	L- MH+ L-	VL VL L-	H+ MH+ MH+	MH+ MH+ M	None. None. Manure and 1400-1600 lb. fertilizer per acre.
Average.....	8	5.9	2.5	1.4	0.16	MH+	M-	VL+	MH+	MH+	All treatments.
Culloden.....	2 3 2	6.1 5.6 5.6	3.0 3.1 3.0	1.2 1.3 1.3	0.13 0.14 0.20	H- VL M+	L VL+ M	M+ VL+ MH	L+ VL+ MH	M L+ M+	None. None. 10-16 tons of manure and 700-1700 lb. fertilizer per acre.
Average.....	7	6.0	3.0	1.3	0.156	MH-	L+	M	M-	M-	All treatments.
O'Leary.....	1 3	5.8 5.8	3.0 2.3	1.75 1.95	0.17 0.155	M H+	VL M+	VL M-	H MH+	M M+	None. 1700-2000 lb. fertilizer per acre (plus manure 1 case).
Average.....	4	5.8	2.6	1.85	0.162	MH+	L+	L-	H-	M+	All treatments.
Kildare.....	1 1	5.9 5.0	1.5 2.5	1.65 0.85	— —	T MH	MH M	VL MH	L VL	M MH	None. 1700 lb. 4-8-8.
Average.....	2	5.4	2.0	1.25	—	MH-	M+	L+	VL+	M+	All treatments.

Symbols: H—High; MH—Medium High; M—Medium; L—Low; VL—Very Low; T—Trace.

These data suggest that although the common practice of applying comparatively large amounts of fertilizers to the potato crop gives some increase in available plant nutrients in that particular year, there does not appear to be any appreciable residual fertility built up for future crop use. The behaviour of many fields tends to confirm this supposition. It was frequently observed that while the practice of applying large amounts of fertilizer to the potato crop, for instance, gives very good yields that year, the quality and quantity of herbage in the succeeding pasture years is not all that could be desired as it quickly reverts to natural grasses, such as brown top and poverty-grass.

The apparent failure of the present manurial practices to build up a residual or cumulative fertility in the soil may have its explanation in certain physical and chemical characteristics of the soil, as well as in the demands of the growing crops. As previously stated in this report the soils of the Island are of such a nature as to encourage very strong leaching, and much of the readily available plant nutrients not utilized by the current crops may be carried down through the soil profile out of reach of plant roots, or out of the soil by drainage waters. Such losses are likely to be rapid in soils of the Culloden, Kildare and Dunstaffnage series. Or again, the lack of cumulative fertility may be due to the ability of certain compounds of iron and aluminum, which occur in soils like those found in Prince Edward Island, to combine with, for instance, the applied phosphoric acid, to form new compounds in which the phosphorus is unavailable to plants.

As previously mentioned, the objective of a soil management program should be to maintain a high level of available plant nutrients in the soil. From the findings of the soil survey it would appear that in general present cultural practices are not achieving this objective. It was stated in the section dealing with the nature of the soil that soil organic matter is an essential part of a true soil. Field observations and laboratory determinations have shown present soil organic-matter levels to be of a low order. Of four hundred samples examined, 80 per cent contained only 3 per cent or less of active organic matter. Soil fertility experiments and crop rotation studies conducted at the Dominion Experimental Farm, Charlottetown, as well as practical experience in progressive farming areas, have shown the basic need for, and the beneficial results obtained from the regular incorporation of organic materials into the soil. Such organic material should be readily decomposable and from sources rich in the nutrient elements. The most desirable source of supply of organic matter on a farm is well preserved barnyard manure from well fed livestock, applied regularly to the land. Green manuring crops, such as buckwheat, fall rye or even oats, and more preferably clovers, provide a very good supplementary or alternative source of supply. To obtain the best results from green manuring crops it would be advisable to apply a dressing of fertilizer when the crop is planted with a further application, particularly of nitrogen, when the green crop is ploughed under. The first application is for the purpose of feeding the crop which would otherwise increase the drain on the plant food in the soil, thus depleting it further of fertility, while the second application is to take care of the competition, by the soil bacteria, responsible for decomposing the green material, for the nitrogen supply. The manuring, or fertilizing, of grasslands in order to build up a thick sward for ploughing under will also aid in supplying soil organic matter. It has been stated that large amounts of commercial fertilizers are used on the farms of the province. The continued and judicious use of fertilizers will be necessary, not only to supply the mineral elements in sufficient quantities for maximum current production but also for the purpose of increasing the vigour of crop growth, and in consequence improving the quantity and quality of the crop residues to be returned to the land, an essential requirement for improving soil fertility or productivity.

SOIL PROBLEM AREAS

(OTHER THAN FERTILITY)

DRAINAGE.....D

EROSION.....E

DROUGHT.....M



In any system of soil management consideration should be given to developing a proper rotation of crops. While no hard and fast rule can be laid down that will suit all farms, the aim should be to alternate soil depleting crops with so-called soil building crops.

Soil Erosion

Although the incidence of soil erosion is not so severe under Prince Edward Island conditions as it is in some other regions, it is, nevertheless, a problem that has contributed in no small measure to the depletion of soil fertility in the province, and will continue to do so unless prompt action is taken to control erosion activities.

While the environmental conditions, climate and vegetation, and to some extent the type of agriculture followed, have in a measure slowed the rate of progress of erosion, conditions are none the less favourable to such activities.

As mentioned in a previous section of the report, the soils of Prince Edward Island contain a fairly high percentage of fine sand and silt particles. Soil particles such as these, as well as the finer particles of clay and humus are carried away readily in suspension by water. With the heavy rainfall of the region occurring in the spring and autumn when the land is usually bare or sparsely covered with vegetation, the surface soils are exposed to the full effects of surface run-off. The sudden downpours which often occur during the growing season when the surface soils are dry and tend to be crusty also cause losses of fertility. The crusty condition is evidence of a lack of proper tilth or physical condition. Soils in such a condition do not absorb water so readily, consequently the volume of surface run-off will be greater than should normally occur. As a result, appreciable quantities of fine soil particles are carried away. Owing to the relatively mild temperatures which prevail in the region, the land is often bare and unfrozen during the winter and early spring and consequently exposed to erosion by both water and wind action.



Fig. 17 Gullying, result of one heavy rain on bare land. Fine sandy loam soil on a 5 per cent slope. Approximately 50 tons of soil removed from about $\frac{1}{4}$ -acre area.

One of the most serious aspects of water erosion is that very often the loss of surface soil is so gradual that it proceeds without being recognized. Very often it is only when gullying occurs or when crop yields drop very markedly, indicating serious loss of soil fertility, that the effects of erosion are manifest. This holds true with respect to Prince Edward Island. While it is generally recognized that in spite of the use of improved varieties of seed and the increased applications of commercial fertilizers crop yields have not materially increased, very little attention has been given to protecting the surface soils from the effects of the heavy precipitation. Thus, even on the smoother topography soil losses occur annually, although they are not always perceptible, nor measurable, except in the case of gully formation.

Although water action is the major agency of soil erosion in Prince Edward Island, wind action is also a factor to be considered. Because of the high percentage of loose, relatively fine sand and silt and the low organic matter content of the soils generally, coupled with the frequency of moderately high winds, soil drifting or wind erosion might well become a serious problem in spite of the moist climate. That such is the case has been demonstrated by the damage done to a small area of sandy soil in the vicinity of Urbanville, Prince county. The effect of wind action over a period of 4 or 5 years resulted in the removal of all the soil down to the parent material, rendering this particular parcel of land unsuitable for crop production.

Among the factors contributing to soil erosion in the province, other than the factors of environment, are: cultivation of land on slopes unsuitable for arable land, cultivating with the slope, too large a proportion of the arable land per farm in row crops and poor grassland resulting in too large an area of unprotected surface soil, as well as the common practice of leaving a large proportion of the cultivated land bare between harvest time and the following spring. Allowing soils to remain bare over winter should be avoided if possible, because of the danger of loss of fertility, not only by wind and water action, but also as a result of leaching.

Approximately 7.7 per cent (105,900 acres) of the area has been classed as marginal land owing to susceptibility to severe erosion. The area, so classed, includes soils of the Charlottetown, Alberry and Cullogen series on the more rolling topography forming Land Use Groups 4 and 6. This, however, is not the whole erosion problem. Much of the better arable land on the smoother topography is erodible if proper cultural practices are not followed.

One of the fundamental measures for controlling soil erosion and soil deterioration is proper utilization of the land. Most of the Charlottetown and Alberry soils included in Land Use Group 4 and 6 would be better used for forest, owing primarily to the character of the topography. It is possible, however, that a large proportion of the soils in Group 4 could be maintained in agricultural use, at reasonably productive levels, provided special erosion control measures were taken, together with the adoption of suggestions for maintaining soil fertility as discussed in the preceding section.

These special control measures may include; (a) avoiding if possible inter-tilled crops on slopes of 8 per cent or more, with definite elimination of such crops on slopes of 15 per cent or over; (b) contour cultivation and strip cropping on slopes over 8 per cent, even on these grades, cross cultivation will be beneficial, as shown by the erosion control experiment at the Dominion Experimental Station, Charlottetown; and (c) increased use of grass cover on the sloping land. The efficiency of grass as a means of controlling erosion and stabilizing the soil has been demonstrated on the Illustration Station located at Long River, Queens county. Where necessary, particularly on the steeper slopes, these measures should be supplemented by the construction of interceptor ridges, conversion ditches and grassed runways for the purpose of breaking the length



Fig. 18 Wind erosion. Illustrates the effect of improper land use. Result of frequent growing of intertilled crops on light sandy land where vegetative cover is removed and soil organic-matter content depleted. Two to 3 feet of soil removed in a period of 5 years.



Fig. 19 Damage by drifting soil to crop on land adjacent to area shown in Fig. 18.

of slope, lessening the run-off and directing the flow of excess water. The grassing of all runways, irrespective of topography, is a practice to be recommended. They should not interfere with the cultivation of the field and will provide some pasturage.

Soil Moisture Conditions.—Among the most frequent, but not always recognizable causes of low fertility or productivity is an unsatisfactory soil moisture-soil air status. Such a condition may be due to the presence of excess water in the soil, (poor drainage conditions) or again, it may be due to lack of sufficient soil moisture during the growing season.

Approximately 428,000 acres (31 per cent) comprise soils in which moisture conditions are, to a greater or lesser degree, the limiting factor in crop growth and agricultural utilization. These include the soils in Land Use Groups 3 and 5 with the Egmont series, in Group 4. The corrective measures in the case of the Egmont and Armadale soils constitute a drainage engineering problem, the feasibility of which requires further study. With respect to the Culloden, Kildare and Dunstaffnage soils proper land use and the maintenance of a high level of soil organic matter are important factors in their management.

As mentioned in the soil descriptions, drainage of the O'Leary and Queens soils tends to be slow. This characteristic not only delays the working of the land in the spring, but also calls for care to be exercised when working them. If they are cultivated when too wet, the structure of the soil is damaged and the soil becomes "puddled", and as a result it may be made unproductive for many years.

It may serve a useful purpose to again reiterate the essential features of a permanent and economical soil fertility and soil conservation program:

- (a) Proper land use.
- (b) Where necessary, establishment of good drainage, construction of diversion ditches, interceptor ridges and grassed runways, contour cultivation and strip cropping.
- (c) Correct soil acidity.
- (d) Maintenance of a high level of soil organic matter.
- (e) Preservation of the physical condition or tilth of the soil and maintenance of satisfactory soil moisture conditions.
- (f) Establishment of a suitable crop rotation system.
- (g) Judicious use of commercial fertilizers.

APPENDIX

Glossary of Terms Used in Description

- Surface Soil*—The upper horizon or surface layer. The term as generally used includes part or all of what is known as the A horizon. In cultivated soils it usually refers to that portion that is modified or stirred by tillage operations. Usually the darkest coloured layer.
- Subsoil*—The horizon or layer of soil beneath the surface horizons. The B horizon or horizons.
- Parent material*—The unweathered or only slightly altered material below the subsoil. The C horizon from which the surface and subsoil has been developed.
- Solum*—The A and B horizons. The portion of the profile that has been weathered or altered by soil forming processes.
- Soil horizon*—A layer or section of the soil profile, more or less well defined, and occupying a position parallel to the soil surface.
- Soil profile*—A vertical column of the soil from the surface down to and including the unconsolidated or unmodified material from which the soil has been formed. It shows the arrangement, thickness, colour, texture, structure, etc. of the different soil horizons.
- Texture*—Refers to the relative size of the individual soil particles or grains, or the fineness or coarseness of the soil mass, i.e. it refers to the relative amounts of sand, silt and clay in the soil.
- Soil structure*—A term expressing the arrangement of the individual soil particles into aggregates.
- Mature soil*—A soil in which the profile shows a full development of the A and B horizons in equilibrium with the environmental factors.
- Ortstein*—Hard, irregularly cemented, dark yellow to nearly black material, usually found in the B horizon.
- Arable*—Refers to land that is suitable for cultivation.
- Till*—Unstratified material left behind by glaciers; unsorted mixture of clay, silt, sand, gravel and boulders.
- Topography-Level*—Practically uniform elevation, only very slight, if any, swells or waves.
- Undulating*—Uniform, low swells or waves. Easily cultivated.
- Gently rolling*—Landscape consists of long, smooth slopes and low ridges. Slopes around 5 to 8 per cent, permits the use of most farm machinery.
- Rolling*—Changes in elevation more frequent, steeper slopes. Use of farm machinery restricted to the lighter types.
- Hilly*—Broken landscape, changes in elevation fairly frequent and relatively high. Slopes variable in length, smoothness and degree of steepness, usually 10 per cent or more.

TABLE 16.—MECHANICAL ANALYSIS OF REPRESENTATIVE PROFILES OF PRINCE EDWARD ISLAND SOILS

Soil Series	Horizon	Depth in inches	Per cent Gravel	Per cent Sand			Per cent Silt 0.05-0.005 mm	Per cent Clay		Textural Class
				Coarse 1.0-.5mm	Medium 0.5-0.23mm	Fine 0.25-0.1mm		Total 0.005mm	Fine 0.002mm	
Charlottetown.....	Cult. Surface	6	—	6.2	15.8	38.4	18.6	10.2	8.4	Fine sandy loam.
	A ₀	2	—	—	—	—	—	—	—	Organic material.
	A ₂	2-6	4	1.4	8.0	36.1	30.0	9.8	8.2	Fine sandy loam.
	B ₁	8	11	1.6	7.7	33.3	32.0	11.2	8.2	Fine sandy loam.
	B ₂	8	10	2.2	8.2	31.8	29.0	13.2	8.2	Fine sandy loam.
	Below C	24	22	1.9	8.7	28.7	31.0	14.0	10.4	Fine sandy loam.
Alberry.....	Cult. Surface	6	—	8.2	22.2	37.8	10.8	11.5	7.4	Fine sandy loam.
	A ₀	1	—	—	—	—	—	—	—	Organic material.
	A ₂	0-7	3	3.7	7.0	42.2	23.4	7.4	5.4	Fine sandy loam.
	B ₁	4-6	14	9.8	5.8	30.5	29.8	11.4	9.8	Sandy loam.
	B ₂	6-9	19	7.0	9.4	35.1	24.4	10.4	6.4	Sandy loam.
	Below C	22	27	5.7	9.3	32.1	24.8	11.4	9.6	Sandy loam.
Culloden.....	Cult. Surface	6	16	3.9	12.2	38.9	20.0	10.2	7.2	Fine sandy loam.
	A ₁	1-2	—	16.2	20.0	32.2	19.6	3.4	2.6	Sandy loam.
	A ₂	2-8	24	24.5	19.3	25.3	18.0	6.0	4.4	Sandy loam.
	B ₁	4-12	16	15.8	20.6	21.8	21.0	11.4	7.4	Sandy loam.
	B ₂	6-8	19	12.6	17.1	23.4	22.8	9.4	6.4	Sandy loam.
	Below C	22	16	10.7	16.9	27.1	19.4	16.2	11.6	Sandy loam.
O'Leary.....	Cult. Surface	4	—	5.6	8.2	22.4	31.6	19.2	15.2	Loam.
	A ₀	2	—	—	—	—	—	—	—	Organic material.
	A ₂	3-5	—	3.1	3.2	14.1	40.0	24.6	19.6	Clay loam.
	B ₁	4	—	4.6	5.3	19.7	34.8	18.8	15.6	Loam.
	B ₂	8-10	—	2.4	4.4	17.3	35.6	24.6	18.6	Clay loam.
	Below C	18	—	4.1	2.9	14.5	37.4	26.6	20.0	Clay loam.

Egmont.....	A ₂ A ₃ B ₁ B ₂ C	3 3-5 0-2 4 4 Below 16	— — — — —	0-5 0-5 1-6 0-9 0-6 4-3	0-5 0-8 1-1 0-4 6-3	1-5 3-9 4-1 10-3 4-5 23-8	5-7 11-7 10-3 12-9 17-0	26-0 39-8 44-4 44-4 17-0	65-8 42-2 39-2 37-2 31-6	57-8 37-2 34-2 30-2 26-2	Clay. Clay. Silty clay. Silty clay. Sandy clay loam.
Queens.....	A ₀ A ₂ B ₁ B ₂ C	1-3 3-6 5-8 8-10 Below 22	— 1-0 3-6 2-8 2-0	— 0-8 0-5 0-4 0-1	— 1-5 1-4 1-3 1-1	— 12-4 13-5 13-3 13-3	— 17-7 17-4 16-3 18-3	— 44-8 44-0 40-4 41-4	— 22-8 23-2 28-3 25-6	— 18-8 17-8 23-8 20-2	Organic material. Silty loam. Silty loam. Silty clay loam. Silty clay loam.
Kildare.....	Cult. Surface A ₀ A ₁ A ₂ B ₁ B ₂ C	4 1 0-2 2-8 5-7 8-12 Below 20	— — — — — —	4-5 — 3-4 3-6 5-8 5-4 4-4	19-2 — 18-1 27-5 26-4 36-3 29-4	44-6 — 43-4 48-8 53-2 48-9 59-3	10-1 — 12-4 5-9 5-8 3-8 4-1	12-6 — 16-0 10-6 5-2 3-4 0-2	9-0 — 6-6 3-6 3-6 2-2 2-6	6-6 — 4-2 3-6 3-2 1-8 2-2	Light fine sandy loam. Organic material. Light fine sandy loam. Loamy fine sand. Fine sand. Fine sand.

TABLE 17.—AVERAGE MECHANICAL ANALYSIS OF 44 SURFACE SOILS FROM REPRESENTATIVE FIELDS

Soil Series	Per cent gravel	Per cent Sand				Per cent silt	Per cent Clay		Textural Class
		Coarse	Medium	Fine	Very fine		Total	Fine	
Charlottetown.....	15.7	6.2	10.9	31.3	12.0	26.2	13.4	10.6	Fine sandy loam.
Alberry.....	16.6	8.4	12.2	30.7	11.1	24.1	12.9	8.4	" "
Cultoden.....	18.3	11.6	14.9	29.6	10.9	21.1	10.3	7.6	" "
Haliburton.....	—	13.7	18.1	29.3	8.6	20.6	9.6	7.8	" "
O'Leary.....	—	6.2	14.3	26.6	12.6	23.2	17.0	12.5	" "
Kildare.....	—	5.4	21.9	43.2	9.9	12.3	7.8	5.8	Loamy fine sand

TABLE 18.—CHEMICAL ANALYSIS OF REPRESENTATIVE PROFILES OF PRINCE
EDWARD ISLAND SOILS

Soil Series	Horizon	Depth in inches	Hyg. Moisture %	Loss on Ignition %	Organic Matter %	pH	Total Nitro- gen %	Per cent Exchangeable		
								Calcium	Magne- sium	Potash
Charlottetown...	Cult. Surface	6	1.9	—	2.5	6.4	0.18	—	—	—
	A ₀	2	8.0	47.6	16.0	3.8	0.98	0.112	0.054	0.041
	A ₂	2-6	0.5	1.0	2.5	4.5	0.05	0.003	0.004	0.000
	B ₁	8	2.5	5.6	0.5	4.9	0.14	0.003	0.003	0.010
	B ₂	8	1.4	2.4	—	5.0	0.06	0.003	0.001	0.006
	C	Below 24	1.0	0.5	—	4.7	0.02	0.002	0.001	0.005
Alberry.....	Cult. Surface	6	1.2	—	1.5	6.2	0.12	—	—	—
	A ₀	1	5.9	37.3	18.0	3.8	0.892	0.100	0.022	0.023
	A ₂	0-7	0.4	0.8	4.0	4.2	0.035	0.007	0.002	0.002
	B ₁	4-6	3.2	6.8	1.5	4.7	0.166	0.006	0.002	0.002
	B ₂	6-9	1.5	3.2	—	4.8	0.088	0.005	0.001	0.002
	C	Below 22	0.8	1.1	—	4.7	0.022	0.003	0.002	0.001
Culloden.....	Cult. Surface	6	1.5	4.1	3.0	5.0	—	—	—	—
	A ₁	1-2	1.8	10.4	9.0	4.4	0.320	0.025	0.006	0.019
	A ₂	2-8	0.3	0.6	—	4.8	0.074	0.010	0.003	0.008
	B ₁	4-12	3.5	7.9	4.0	4.7	0.210	0.007	0.003	0.003
	B ₂	6-8	1.5	2.5	1.0	5.1	0.112	0.004	0.001	0.008
	C	Below 22	0.9	0.9	—	5.1	0.310	0.003	0.002	0.005
O'Leary.....	Cult. Surface	4	1.7	—	3.0	5.8	0.17	—	—	—
	A ₀	2	9.7	42.9	13.5	3.4	1.060	0.022	0.026	0.014
	A ₂	3-5	1.2	2.9	1.5	4.4	0.060	0.006	0.006	0.003
	B ₁	4	2.0	3.3	1.5	5.0	0.070	0.004	0.003	0.005
	B ₂	8-10	1.5	2.2	0.5	5.1	0.040	0.003	0.002	0.003
	C	Below 18	1.0	1.1	—	5.4	0.030	0.008	0.008	0.007
Egmont.....	A	3	7.3	27.0	8.0	4.8	0.878	0.277	0.022	0.030
	A ₂	3-5	3.4	4.2	3.5	5.3	0.134	0.246	0.022	0.002
	A ₃	0-2	2.1	1.8	0.5	6.0	0.044	0.155	0.018	0.001
	B ₁	4	2.9	1.3	0.5	6.4	0.037	0.164	0.018	0.002
	B ₂	4	2.6	1.3	—	7.0	0.030	0.177	0.021	0.004
	C	Below 16	2.0	0.7	—	8.3	0.029	0.253	0.012	0.002
Queens.....	A ₀	½-3	5.0	—	22.0	4.2	0.582	0.037	0.019	0.015
	A ₂	3-6	1.1	1.7	1.5	4.6	0.034	0.008	0.004	0.003
	B ₁	5-8	0.7	1.5	1.0	4.8	0.032	0.009	0.001	0.003
	B ₂	8-10	0.7	0.9	—	4.8	0.024	0.014	0.005	0.004

TABLE 19.—READILY AVAILABLE NUTRIENTS BY MORGAN RAPID TEST METHOD⁽¹⁾

Soil Series	Horizon	Phosphorus		Potash		Calcium		Magnesium	
		Range	Pounds per acre	Range	Pounds per acre	Range	Pounds per acre	Range	Pounds per acre
Charlottetown...	Cult. Surface A ₀ ⁽²⁾ A ₂ B ₁ B ₂ C	L	70	L	170	M	1,260	H	150
		H	42	VH	37	VL	22	MH	7
		VL	20	VL	95	—	—	VL	8
		VL	20	T	95	—	—	VL	8
		VL	20	VL	95	—	—	L	25
		L	70	T	95	—	—	T	8
Albery.....	Cult. Surface A ₀ ⁽²⁾ A ₂ B ₁ B ₂ C	M	150	VL	95	MH	2,000	L	25
		M	14	T	95	—	—	MH	7
		VL	20	—	—	—	—	L	25
		VL	20	—	—	—	—	VL	8
		VL	20	—	—	—	—	VL	8
		M	150	—	—	—	—	T	8
Culloden.....	Cult. Surface A ₁ A ₂ B ₁ B ₂ C	M	150	VL	95	—	—	VL	8
		VH	740	H	340	VL	225	H	150
		L	70	VL	95	VL	225	M	50
		L	70	T	95	T	225	VL	8
		L	70	—	—	—	—	VL	8
		L	70	T	95	T	225	L	25
O'Leary.....	Cult. Surface A ₀ ⁽²⁾ A ₂ B ₁ B ₂ C	VL	20	VL	95	H	4,000	M	50
		H	42	H	33	VL	22	M	4
		L	70	VL	95	VL	225	VL	8
		MH	220	T	95	VL	225	VL	8
		M	150	T	95	VL	225	VL	8
		VH	740	VL	95	L	670	L	25
Egmont.....	A A ₂ A ₃ B ₁ B ₂ C	L	70	T	95	M	1,260	MH	75
		L	70	VL	95	L	670	M	50
		L	70	T	95	MH	2,000	M	50
		VL	20	VL	95	H	4,000	M	50
		MH	220	—	—	VH	6,700	H	150
		MH	220	—	—	VH	6,700	H	150
Queens.....	A ₀ ⁽²⁾ A ₂ B ₁ B ₂ C	MH	21	VL	9	—	—	H	14
		VL	20	—	—	—	—	VL	8
		VL	20	—	—	—	—	VL	8
		H	440	—	—	—	—	L	25
		MH	220	VL	95	VL	225	M	50
Kildare.....	Cult. Surface A ₀ ⁽²⁾ A ₁ A ₂ B ₁ B ₂ C	MH	220	VL	95	L	670	M	50
		H	42	VH	37	H	4,000	MH	7
		MH	220	L	170	L	670	L	25
		VL	20	T	95	T	225	VL	8
		L	20	T	95	T	225	VL	8
		L	20	T	95	T	225	VL	8
		L	20	T	95	T	225	VL	8

(1) Pounds per acre calculated as P₂O₅, K₂O, CaO, MgO.

(2) Calculated on basis of 193,000 lb. soil per acre.

Symbols:—

VH Very High

H High

MH Medium High

M Medium

L Low

VL Very Low

TABLE 20.—AVAILABLE NUTRIENTS POUNDS PER ACRE

(Calculated from data, Table 18)

Soil Series	Horizon	Nitrogen	Calcium	Magnesium	Potash
Charlottetown.....	Cult.				
	Surface	3,600	—	—	—
	A ₀ ⁽¹⁾	1,891	216	104	79
	A ₂	1,000	60	80	100
	B ₁	2,800	60	60	260
	B ₂	1,200	60	20	120
	C	400	40	20	100
Alberry.....	Cult.				
	Surface	2,400	—	—	—
	A ₀ ⁽¹⁾	1,721	193	42	44
	A ₂	700	140	40	40
	B ₁	3,320	120	40	40
	B ₂	1,760	100	20	40
	C	440	60	40	20
Culloden.....	Cult.				
	Surface	2,800	—	—	—
	A ₁	1,273	600	120	380
	A ₂	4,000	200	60	160
	B ₁	2,400	140	60	60
	B ₂	1,000	80	20	160
	C	400	60	40	100
O'Leary.....	Cult.				
	Surface	3,400	—	—	—
	A ₀ ⁽¹⁾	2,045	42	50	27
	A ₂	1,200	120	120	60
	B ₁	1,400	80	60	100
	B ₂	800	60	40	60
	C	600	160	160	140
Egmont.....	A ₀ ⁽¹⁾	1,694	527	42	60
	A ₂	2,680	4,920	440	40
	A ₃	880	3,100	360	20
	B ₁	740	3,280	360	40
	B ₂	600	3,540	420	80
	C	580	5,060	240	40
Queens.....	A ₀ ⁽¹⁾	1,123	71	37	29
	A ₂	680	160	80	60
	B ₁	640	180	20	60
	B ₂	560	280	100	80
	C	460	420	80	80
Kildare.....	A ₀ ⁽¹⁾	652	230	37	48
	A ₁	1,680	300	120	60
	A ₂	480	60	40	40
	B ₁	800	60	20	80
	B ₂	400	120	40	80
	C	240	280	60	60

⁽¹⁾ A₀ Horizons—calculated on basis of 193,000 lb. per acre.

TABLE 21.—AVAILABLE PLANT NUTRIENT LEVELS OF 153 SURFACE SOILS FROM REPRESENTATIVE FARMS
PER CENT OF SAMPLES IN EACH NUTRIENT RANGE (MORGAN METHOD)

Soil Series	Num- ber of Samples	Organic matter			Nitrate Nitrogen		Phosphorus		Potash		Calcium		Magnesium		Soil Reaction								
		High 3.5 per cent or over	Me- di- um 2.0- 3.0 per cent	Low 1.5 per cent or less	—	—	—	—	—	—	—	—	—	—	Extrem- ly acid pH 5.0 or less	Strongly acid 5.2-5.6	Medium acid 5.8-6.2	Slightly acid 6.4-6.8					
Charlottetown.....	81	24.6	71.0	4.4	16.1	15.0	68.9	8.7	23.4	67.9	21.1	6.2	72.7	40.7	32.1	27.2	24.8	59.2	16.0	—	46.6	36.8	16.6
Alberry.....	24	—	96.6	3.4	25.0	25.0	50.0	8.2	37.7	54.1	16.8	—	83.2	50.2	23.2	16.6	16.6	66.8	16.6	—	36.8	46.7	16.5
Culloden.....	17	—	94.0	6.0	—	29.4	70.6	—	35.3	64.7	17.7	5.9	76.4	11.8	17.7	70.5	5.3	59.6	35.1	8.8	43.5	30.3	17.4
Halburton.....	10	—	100.0	—	30.0	40.0	30.0	10.0	30.0	60.0	50.0	10.0	40.0	50.0	30.0	20.0	50.0	40.0	10.0	—	22.2	44.4	33.3
O'Leary.....	15	—	100.0	—	26.7	40.0	33.3	46.8	26.6	26.6	13.3	—	86.7	53.3	20.0	26.7	20.0	80.0	—	8.3	8.3	58.3	25.0
Kildare.....	8	—	75.0	25.0	12.5	50.0	37.5	37.5	37.5	25.0	37.5	25.0	37.5	25.0	12.5	62.5	25.0	75.0	—	—	80.0	20.0	—

TABLE 22.—NATURAL VEGETATION CHARACTERISTIC OF PRINCE EDWARD ISLAND

ASSOCIATION	Botanical Name	Common Name
Hardwood	<i>Acer Saccharinum</i> L.	White or silver maple
	<i>Acer rubrum</i>	Red maple
	<i>Acer Pennsylvanicum</i> L.	Striped maple or moosewood
	<i>Acer spicatum</i> Lam.	Mountain maple
	<i>Acer saccharum</i> Marsh.	Sugar or rock maple
	<i>Quercus rubra</i> L.	Red oak
	<i>Fagus grandifolia</i> Ehrh.	American beech
	<i>Fraxinus americana</i> L.	White ash
	<i>Betula Populifolia</i> Marsh.	White birch
	<i>Betula lutea</i> Michx. f.	Yellow birch
	<i>Ulmus americana</i> L.	White American elm
	<i>Trillium erectum</i> L.	Purple trillium
	<i>Trillium undulatum</i> Willd.	Painted trillium
	<i>Oxalis acetosella</i> L.	Wood sorrel
<hr/>		
	Botanical Name	Common Name
Mixed-Woods ...	<i>Picea canadensis</i> (Mill) BSP.....	White spruce
	<i>Picea rubra</i> (Du Roi) Dietr.	Red spruce
	<i>Picea mariana</i> (Mill) BSP.	Black spruce
	<i>Pinus Strobus</i> L.	White pine
	<i>Pinus resinosa</i> Ait.	Red pine
	<i>Abies balsamea</i> (1) Mill.	Balsam fir
	<i>Tsuga canadensis</i> (1) Carr.	Hemlock
	<i>Larix laricina</i> (Du Roi) Koch.....	Larch or Tamarack
	<i>Thuja occidentalis</i> L.	White cedar
	<i>Populus balsamifera</i> L.	Balsam poplar
	<i>Populus grandidentata</i> Michx.	Large-toothed aspen or poplar
	<i>Populus tremuloides</i> Michx.	American aspen
	<i>Betula populifolia</i> Marsh.	White birch
	<i>Prunus virginiana</i> L.	Choke cherry
	<i>Taxus canadensis</i> Marsh.	American yew
	<i>Linnæa borealis</i> L.	Twin flower
	<i>Trientalis americana</i> (Per) Pursh	Star flower
	<i>Clintonia borealis</i> (Ait.) Raf.	Yellow clemtonia
	<i>Myrica carolinensis</i> Mill.	Bayberry
	<i>Myrica asplenifolia</i> L.	Sweet fern
	<i>Osmunda cinnamomea</i> L.	Cinnamon fern
	<i>Pteris aquilina</i> L.	Bracken
	<i>Lycopodium lucidulum</i> Michx. Geum ..	Shiny club moss
<hr/>		
Heath plants—	Botanical Name	Common Name
Peat Bogs	<i>Rhododendron canadense</i> (L) BSP	Rhodora
	<i>Ledum groenlandicum</i> Oeder	Labrador tea
	<i>Kalmia augustifolia</i> L.	Sheep laurel
	<i>Sarracenia purpurea</i> L.	Pitcher plant
	<i>Chamaedaphne calyculata</i> (L) Moench.	Leather leaf
	<i>Vaccinium Oxycossos</i> L.	Small cranberry
<hr/>		
	Botanical Name	Common Name
Sand Dunes	<i>Lathyrus maritimus</i> (L) Bigel.	Sand-pea
	<i>Salsola Kali</i> (L)	Saltwort
	<i>Ammophila arenaria</i> (L) Link	Sand grass
	<i>Cakile edentula</i> (Bigel.) Hook	Sea rocket

	Botanical Name	Common Name
Salt Marsh	<i>Spartina pectinata</i>	Marsh grass
	<i>Salicornia europaea</i> (L.)	Glasswort
	<i>Spergularia marina</i> (L.) Griseb.	Saltmarsh sand spurrey
<hr/>		
Open meadows and pas. ures—	Botanical Name	Common Name
Grasses	<i>Agrostis</i>	Brown top
	<i>Festuca ovina</i> L.	Sheep's fescue
	<i>Danthonia spicata</i> (L.) Beauv.	Wild-oat grass
	<i>Poa pratensis</i> L.	Kentucky blue grass
	<i>Agropyron repens</i> L. Beauv.	Couch grass
	<i>Phalaris canariensis</i> L.	Canary grass
	<i>Anthoxanthum odoratum</i> L.	Sweet vernal grass
	<i>Calamagrostis canadensis</i> (Michx) Beauv.	Blue joint grass
<hr/>		
	Botanical Name	Common Name
Weeds	<i>Sonchus arvensis</i> L.	Perennial sowthistle
	<i>Hieracium aurantiacum</i> L.	Devil's paint brush or orange hawkweed
	<i>Hieracium pratense</i> Tausch.	Yellow hawkweed or king devil
	<i>Hieracium Pilosella</i> L.	Mouse-eared hawkweed
	<i>Ranunculus</i>	Buttercup
	<i>Chrysanthemum Leucanthemum</i> L.	Ox-eye daisy
	<i>Achillea Millefolium</i> L.	Yarrow
	<i>Daucus Carota</i> L.	Wild carrot
	<i>Polygonum Persicaria</i> L.	Lady's thumb or smartweed
	<i>Chenopodium album</i> L.	Lamb's quarter
	<i>Echinochloa crusgalli</i> (L.) Beauv.	Barnyard grass
	<i>Raphanus Raphanistrum</i> L.	Wild radish

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SOIL MAP
OF
PRINCE COUNTY
PRINCE EDWARD ISLAND

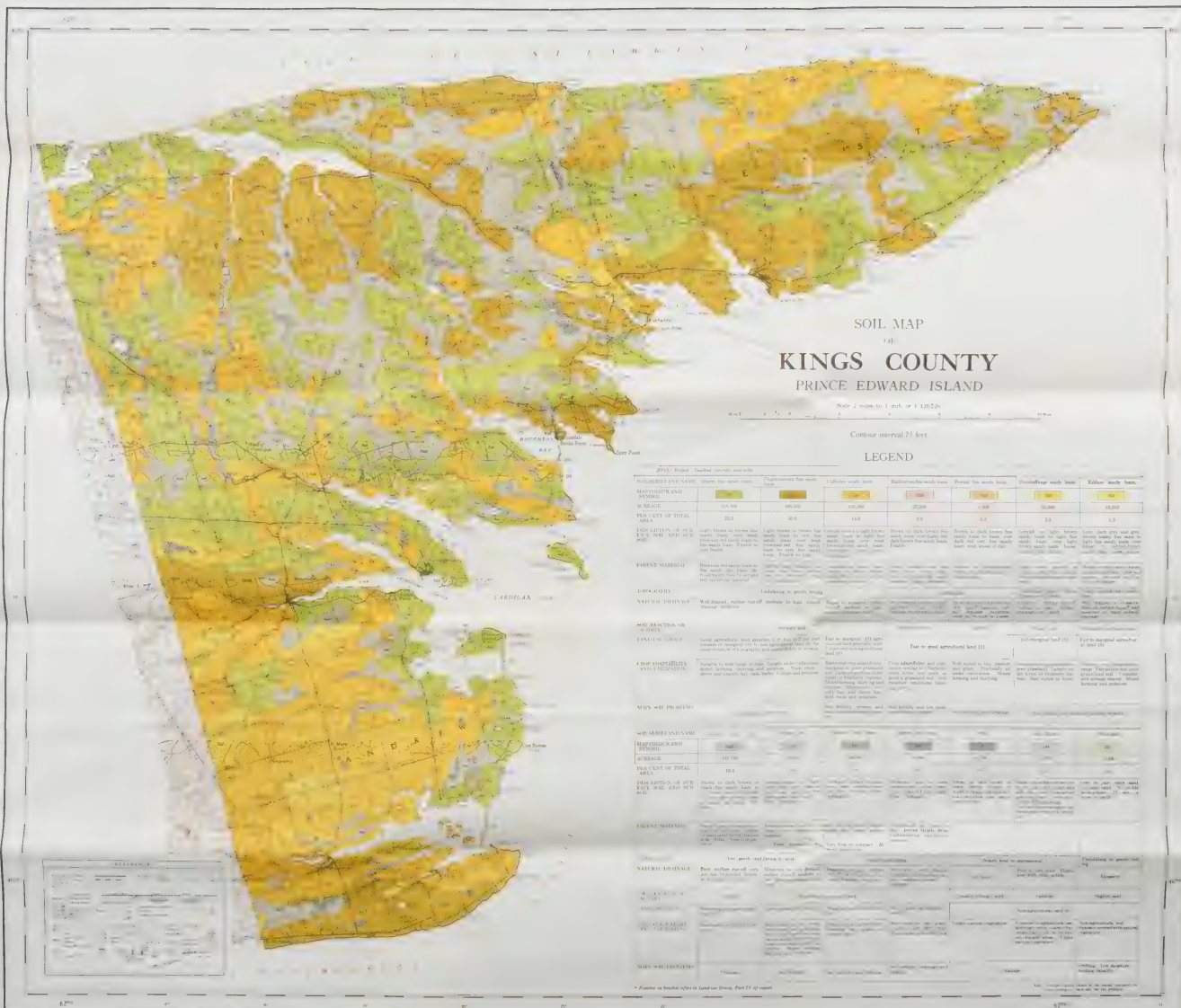
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LEGEND

POINT, Label, Emblem, symbols and notes	L	E	M	B	S
BIRD SPECIES AND NAMES	Where first study done	California, Alaska, etc.	Hawaii, the Hawaiian Is.	Pacific Islands, etc.	Where study done
BREEDING PERIOD AND NESTING	L	E	M	B	S
PERCENT OF TOTAL	20	100	100	100	100
NO. OF SPECIES OF WHICH	10	100	100	100	100
REASON FOR STUDY	Light birds in lowland forest	Light birds in lowland forest	Light birds in lowland forest	Light birds in lowland forest	Light birds in lowland forest
PARIST MATERIAL	Parist material	Parist material	Parist material	Parist material	Parist material
TO-PHOTO	To photograph	To photograph	To photograph	To photograph	To photograph
NATURAL DRAINAGE	Natural drainage	Natural drainage	Natural drainage	Natural drainage	Natural drainage
NO. REACTION OR	No reaction	No reaction	No reaction	No reaction	No reaction
LANDING GEAR	Landing gear	Landing gear	Landing gear	Landing gear	Landing gear
IN-BREEDING	In-breeding	In-breeding	In-breeding	In-breeding	In-breeding
IN-BREEDING	In-breeding	In-breeding	In-breeding	In-breeding	In-breeding
MANUSCRIPT	Manuscript	Manuscript	Manuscript	Manuscript	Manuscript
REASON FOR STUDY	Reason for study	Reason for study	Reason for study	Reason for study	Reason for study
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